METAL INDUSTRY
FABRICATION · ASSEMBLING · PLATING · FINISHING
VOL. 36, NO. 8 AUGUST, 1938

Editorial

Recovery

A little over 100 years —in 1837—America suffered a major financial panic. Banks with Federal deposits failed; trade came to a standstill. Fear was widespread in the land. Late in 1838, however, cotton boomed, trade took heart and in a few short months we were back in prosperity.

Business today seems vastly different from business 100 years ago, but in one respect it is exactly the same. It can be led—up or down—by one outstanding industry. In those days Cotton was King. Today we have no single ruler, but we have several giant industries, any one of which is powerful enough to turn the tide.

What is the state of business today? It is taking heart. For several weeks the Business Index has climbed steadily. Steel, one of our giants, has risen from something over 20% operation to 39.8%. Metal prices have not only stopped falling but have leaped upward. Freight car loadings and scrap steel prices, two of our most reliable indicators, have improved. The rate of operations of the great brass mills in Connecticut has picked up.

The stock market—that over-sensitive barometer—is known to be a faulty index of business. It rarely reflects existing conditions accurately. It may reflect coming events however, and we know without question that it certainly reflects *sentiment*. And sentiment has changed.

The reasons for such a change we never know until long after they have happened. Inventories are said to be low today. Perhaps they are down to the irreducible minimum which forces business to re-stock. Perhaps the effect of the Government "Spend and Lend" program is beginning to be felt. For any reason at all—we are told on every hand that inquiries are more numerous and of more substantial character. Salesmen are reporting that they get better hearings from their prospects. Potential orders are banking up.

We are no long-term prophets. We cannot time rises and falls to the day. But from all indications evident to us, from data ranging from broad industrial and financial statistics to reports from individuals in many scattered localities, the low point is behind us and we now are moving to higher ground.

For how long we do not know, but at this moment recovery is coming up over the horizon.

Metal Prices Rising

The change in the course of metal prices during the past month has been so decisive that it merits the closest attention. Copper, zinc, tin and lead have almost simultaneously turned upward. The reasons for their turn are not yet all clear but the outlines of certain factors can be discerned.

In the case of copper, for example, we have the fact that foreign stocks of refined metal have been falling for some months while the American stocks have been rising.

American consumption has been very low, negligible quantities going into munitions and industrial consumption being at a low ebb. Consequently, American producers have been reducing their output steadly and, according to June statistics, have succeeded in reducing stocks for the first time in many months. And although American prices are influenced to a large degree by the speculative London market, the change in the trend of refined stocks in America is probably the most bullish factor in the American market.

Fundamentally, however, the market for copper and the other metals will be really sound only when industry and the utilities resume their fair share of consumption.

Research Essential

Appropriation for research in the United States in 1937, it has been estimated, reached a total of about $250,000,000. During the last twenty-five years the number of industrial research laboratories in the United States has multiplied from a handful to over 2,000.

To this expansion, metal products manufacturing has contributed its full share. The chemical industry is one of the largest and staunchest supporters of research. But others, even though they were accompanied by no flourish of trumpets, have kept pace. For example, the A.E.S. research project on electroplating—small in comparison to many others—has merit far beyond its "size" in dollars expended.

For industry, research makes new products and fills in gaps left by the disappearance of obsolete items. For the nation, research makes new industries and creates new jobs. It is well for us that we have accepted research as an indispensable cog in our economic machine, as in our present state, our hope for the future rests upon new industries and the wider distribution of the products of old industries.

Cost Reduction in the Plating Department

Results from a practical plan of wage incentive in large manufacturing plant.

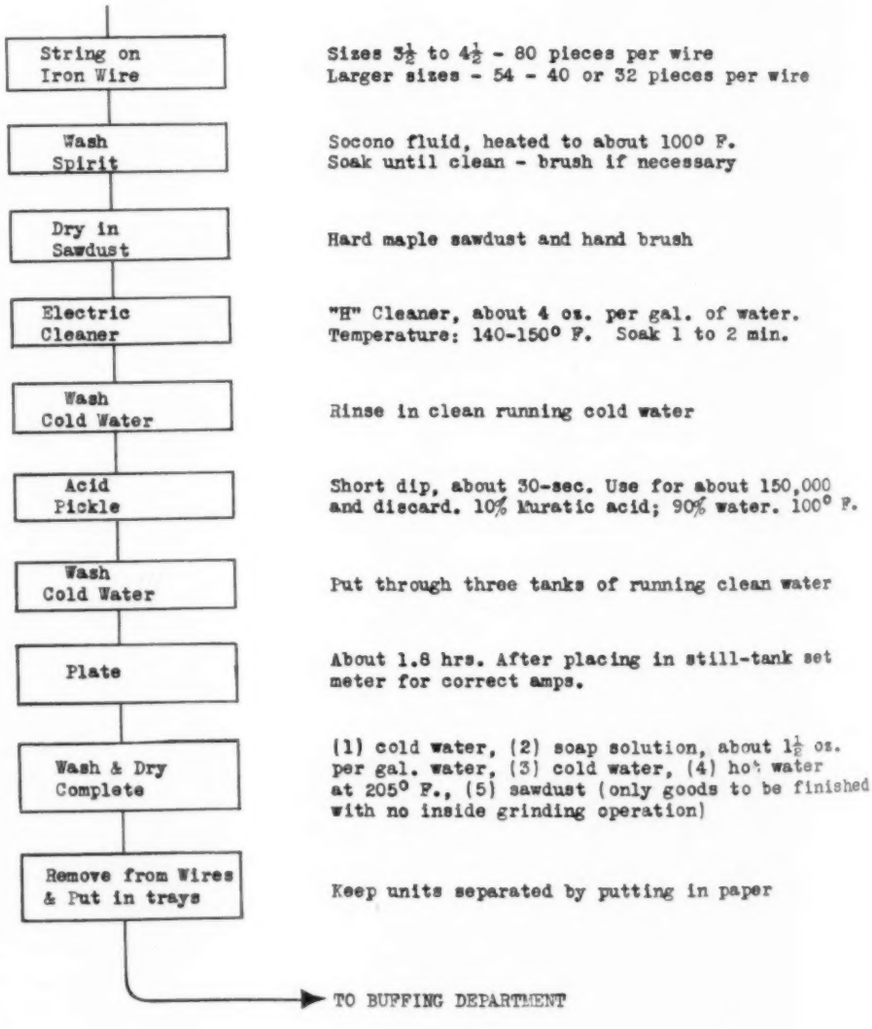
By C. F. SCRIBNER, M. E.
C. F. Scribner & Associates, Bridgeport, Conn.

FACED with a substantial increase in wage rates in their plating department, the management of a prominent eastern metal-working concern gave serious consideration to the standardization of operating conditions; the establishment of task standards; and the application of a practical wage incentive plan which would be simple in its clerical operation; easily understood by the workers; would be an essential part of their standard cost system; and would increase employee earnings, at the same time reducing production costs.

Production from this department averaged about 8,500,000 pieces per year, comprised of four classes of product which required establishing four different standard rates. The usual preliminary and subsequent operations to plating were performed in this department, as shown in the flow chart, Fig. 1. Only six workers were employed and all work was still-tank plated.

Investigation and analysis of the preceding four months' work, which had been done entirely on an hourly rate basis for all employees, showed an average direct labor cost of $.6131 per 1000 pieces for this sequence of operations and this was accepted as representative performance under the day-work plan of wage payment. Factory expense was 175 per cent which, added to the direct labor cost, gave a department cost of $1.686 per 1000 pieces for the plating operation.

Under day-work and even with adequate supervision, it was found that the full labor force was employed whether there was 150 gross or only 80 gross put through on a given day. As employees were paid for the time they put in it was natural for them to see that they always had something to do in order to put in this time. There was no incentive for them to make their efforts most effective and productive. Under this incentive plan they were paid a certain number of man-hours for each 1000 pieces and it did not matter how much unneces-



C. F. Scribner, M.E.
Management Consultant

Fig. 1. Flow sheet of the nickel plating department.

sary delay they built up, their earnings were fixed by the amount of work they turned out.

The first step was to recognize the distinction between "machine operating load" and the labor load. The tasks were planned and set and the labor force assigned so that all the cleaning, handling, etc., was done during the plating period, plus time for removing the work from the tanks and charging the next batch. This balance was obtained by making detailed time studies of each element in the sequence based on the various sizes. When these time studies were analyzed and compared it was found practical to group the work into the four classes designated below. In setting the tasks, the time from the studies had added to it a percentage to cover fatigue, personal needs, necessary delays and an inventive factor amounting to about 12 per cent.

The task standards which were established were as follows:

Class A— .936 man-hours per 1000 pieces
Class B—1.373 man-hours per 1000 pieces
Class C—1.810 man-hours per 1000 pieces
Class D—2.278 man-hours per 1000 pieces

Previous day-work performance had averaged 81 per cent of these standards and under the plan of wage incentive adopted, 100 per cent task had to be realized before the workers made their base rates. The results for the first 32 weeks' operation under this plan, as compared with the previous day-work performance, are shown in the graphic chart, Fig. 2.

Each employee punched In-and-Out on a clock card in the usual way. Further, each employee had a base hourly rate in relation to his importance in the group. At the end of the week the total production for the week, according to classes, was multiplied by the Standard Hours for each class and the resulting total gave the number of "Standard Hours Earned" during that week. This, divided by the "Total Hours Worked", taken from the clock cards of all employees, gave the percentage of productive efficiency. Some employees would work a less number of hours than others, hence adjustment had to be made in their earnings.

If one employee worked 50 hours during the week; had a base rate of $.52 per hour, and the productive efficiency for that week was 114 per cent, then his earnings for the week would be:

$.52 x 50 x 1.14 = $29.64

Similarly, if another employee worked 42 hours that same week; had a base rate of $.46 per hour, and with productive efficiency the same, then his earnings for that week would be:

$.46 x 42 x 1.14 = $22.02

The net result of this application of wage incentives was: an increase in employee earnings amounting to 12 per cent; an increase in department output amounting to 37.8 per cent; and a net reduction in department manufacturing cost—after payment of 12 per cent higher wages—amounting to 22.9 per cent, with greater interest on the part of employees and a fixed direct labor cost which was entirely lacking under the older form of day-work wage payment.

Altogether, the savings made in this department, directly and indirectly through the incentive plan, amounted to approximately $6,000.00 per year, with employees expressing themselves as being entirely opposed to return to the former method of wage payment under any conditions.

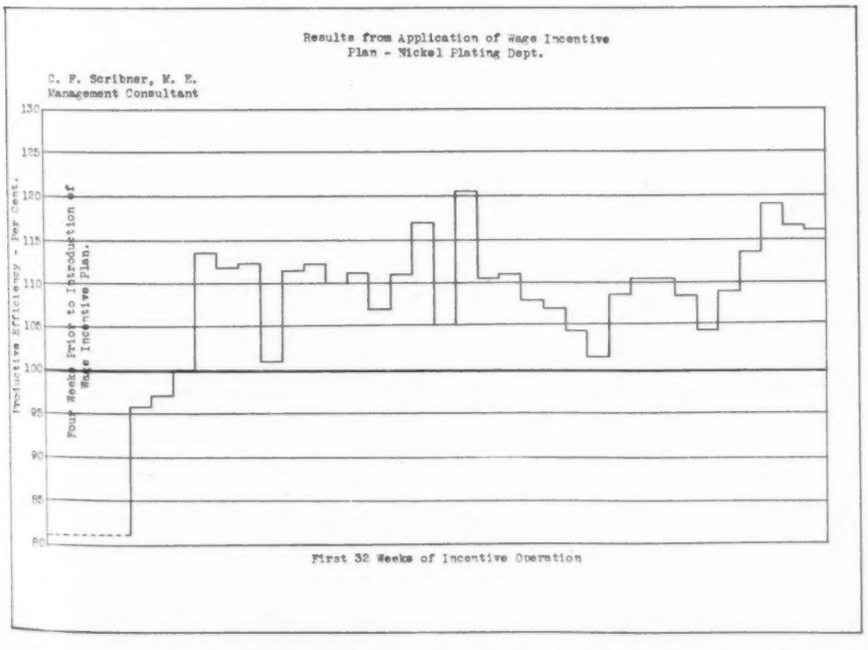


Fig. 2. Chart showing the production efficiency under the wage incentive plan.

Preventing Rust from Perspiration

Q.—In the tool and die making trade it is necessary to handle highly finished tools and as you may perhaps know, there are certain mechanics who have the misfortune to be afflicted with a condition which causes them to rust any tool or finished products which they handle. While this condition is not abnormal, it is a nuisance when one has continually to repolish tools.

Do you know of any solution which may be applied to the hands or is there medical treatment for such a condition? My job is such that I handle costly instruments and have to be very careful lest I rust them.

A.—The writer has not been able to discover any proprietary product that can be applied to the hands of a person to prevent the tarnishing or rusting of steel caused by excessive acid in perspiration. The problem is one that confronts the metal working industry and one of the most difficult to handle.

In some instances where polished steel articles have to be handled, they are first slushed in mineral oil to which has been added a small amount of refined petrolatum. To obtain a thin uniform protective film the mixture can be heated to about 150 deg. F. If this procedure is not feasible, the use of powdered air-slacked lime on the hands of the operator will afford fairly good protection against corrosion. However, in cases where a person's perspiration is extremely acid in nature, it is difficult to prevent such a person from tarnishing anything handled.—T. H. C.

Exposure Tests of Plating on the Non-Ferrous Metals

A report of the Joint Committee of the A.E.S., the A.S.T.M. and the Bureau of Standards.*

SINCE this committee was organized in 1935, its membership has been increased by two additional persons each from the American Society for Testing Materials and the American Electro-Platers' Society. It is now constituted as follows:

	Representing
William Blum, chairman, National Bureau of Standards, Washington, D. C.	N.B.S.
T. H. Chamberlain, New Haven Clock Co., New Haven, Conn.	A.E.S.
B. H. McGar, Chase Brass and copper Co., Waterbury, Conn.	A.E.S.
C. F. Nixon, Ternstedt Division, General Motors Corp., Detroit, Mich.	A.E.S.
W. M. Phillips, General Motors Corp., Detroit, Mich.	A.E.S.
W. A. Wesley, International Nickel Co., Bayonne, N. J.	A.E.S.
C. H. Sample, Bell Telephone Laboratories, New York City.	A.S.T.M., Committee A-5
J. R. Freeman (Alternate *A. W. Tracy*), American Brass Co., Waterbury, Conn.	A.S.T.M., Committee B-3
Sam Tour, Lucius Pitkin, Inc., 47 Fulton St., New York City.	A.S.T.M., Committee B-3
J. C. Fox, Doehler Die Casting Co., Toledo, Ohio.	A.S.T.M., Committee B-6
Carl Heussner, Chrysler Corp., Detroit, Mich.	A.S.T.M., Committee B-6

*Presented at the 41st Annual Meeting of the American Society for Testing Materials, in Atlantic City, N. J., June 27-July 1.

[1] *Proceedings*, Am. Soc. Testing Mats., Vol. 36, Part I, p. 212 (1936).

Program:

The specimens listed in the 1936 report[1] of the Joint Committee were exposed in 1936 in six locations. Since then they were inspected at regular intervals and in general yielded consistent results. After discussion of these data at a conference in Chicago, Ill., on March 3, 1937, it was decided to prepare and expose certain supplemental specimens in order to confirm or extend the results obtained with the original sets. The new specimens were prepared at the National Bureau of Standards by *P. W. C. Strausser* and *J. P. Huff*, employed on the Research Fund of the American Electro-Platers' Society.

At a meeting in New York City in June, 1937, it was decided to include some zinc-base die castings plated in commercial plants with coatings of known thickness. These were accordingly made under the supervision of *P. W. C. Strausser*, A.E.S. Research Associate, in the plants of the *Ternstedt Division* of *General Motors Corp.*, Detroit; the *W. B. Jarvis Co.*, Grand Rapids; and the *Philip Sievering Inc.*, New York City. In all of these plants bright nickel coatings were regularly employed, and were therefore applied to these specimens. The compositions of these bright nickel baths were not disclosed.

At a meeting in Washington, D. C., on October 6, 1937, it was decided to include certain specimens plated with bright nickel at the National Bureau of Standards from proprietary solutions, the compositions of which will not be disclosed. The specimens plated by the different bright processes have been marked alike and are indistinguishable from each other, so that the results of exposure tests will merely show whether, on the average, bright nickel deposits differ materially in their protective action from plain nickel deposits of the same thickness. These specimens were plated at the National Bureau of Standards with the cooperation of the *McGean Chemical Co.*, *Harshaw Chemical Co.*, *Hanson-Van Winkle-Munning Co.*, and the *Pyrene Mfg. Co.*

Equipment and Materials:

The base metals used in these supplemental tests had the compositions listed under the same numbers in the 1936 report.[2] They were donated by the following firms:

No. I—Cold-rolled steel. American Steel and Wire Co.

No. II—Full cold-rolled steel. The Stanley Works.

No. X—Rolled high brass. Chase Brass and Copper Co.

No. XXI—Zinc alloy die castings. New Jersey Zinc Co.

No. XXIII—Zinc alloy die castings. New Jersey Zinc Co.

[2] Loc. cit.

TABLE I.—Coatings on Steel

Set	Steel	Coating	Coating Thickness, in.			Variation
			Copper	Nickel	Chromium	
No. S 101 A	No. I	Ni, Cr	-------	0.001	0.00002	Standard Ni, Cr
No. S 109 A	No. I	Cu (Cy), Ni, Cr	0.0005	0.0005	0.00002	Copper layer
No. S 109 B	No. I	Cu (Cy), Ni, Cr	0.0005	0.0005	0.00002	Bright nickel
No. S 181 A	No. II	Ni, Cr	-------	0.001	0.00002	Like S 101 A, different steel
No. S 189 A	No. II	Cu (Cy), Ni, Cr	0.0005	0.0005	0.00002	Like S 109 A, different steel
No. S 189 B	No. II	Cu (Cy), Ni, Cr	0.0005	0.0005	0.00002	Like S 109 B, different steel

Special equipment and materials required were donated by the following firms:

Vapor degreasing equipment—Detroit Rex Products Co.

Trichlorethylene—Detroit Rex Products Co.

Nickel anodes—International Nickel Co.

Buffing compounds—Hanson-Van Winkle-Munning Co.

Buffs—Hanson-Van Winkle-Munning Co.

Copper anodes—Revere Copper and Brass Co.

Nickel carbonate—Harshaw Chemical Co.

Nickel chloride—Harshaw Chemical Co.

Nickel sulfate—Harshaw Chemical Co.

Anode bags—Harshaw Chemical Co.

Rochelle salt—Grasselli Chemical Dept., E. I. du Pont de Nemours and Co., Inc.

Boric acid—Grasselli Chemical Dept., E. I. du Pont de Nemours and Co., Inc.

Chromic acid—Mutual Chemical Co. of America.

Sodium metasilicate—Philadelphia Quartz Co.

Schedule of Deposits:

In the following tables, "Cy" refers to a Rochelle salt-cyanide copper bath; "S" to a standard nickel bath, and "HS" to a high-sulfate-nickel bath. The bath compositions and the details of the cleaning and plating processes were given in a report of *P. W. C. Strausser* to the American Electro-Platers' Society in Milwaukee, Wis., on June 13, 1938, and will be published in the A.E.S. *Monthly Review*.

TABLE II.—Coatings on Rolled High Brass

Set	Coating	Coating Thickness, in.		Variation
		Nickel	Chromium	
No. B 31 A	Ni, Cr	0.0002	0.00002	Standard Ni, Cr
No. B 31 B	Ni, Cr	0.0002	0.00002	Bright nickel
No. B 31 C	Ni, Cr	0.0002	0.00002	No organic degreaser
No. B 32 A	Ni, Cr	0.0001	0.00002	Thickness nickel
No. B 33 A	Ni, Cr	0.0002	0.00003	Thickness chromium
No. B 34 A	Ni, Cr	0.0005	0.00002	Thickness nickel
No. B 34 B	Ni, Cr	0.0005	0.00002	Bright nickel
No. B 35 A	Ni, Cr	0.0002	0.00001	Thickness chromium
No. B 36 A	Ni, Cr	0.0003	0.00002	Thickness nickel
No. B 37 A	Ni, Cr	0.0002	0.00005	Thickness chromium
No. B 38 A	Ni	0.0002	-------	No chromium
No. B 47 A	Ni, Cr	0.00005	0.00002	Thickness nickel
No. B 56 A	Ni, Cr	0.00015	0.00002	Thickness nickel
No. B 57 A	Ni, Cr	0.001	0.00002	Thickness nickel
No. B 58 A	Ni, Cr	0.0002	0.000005	Thickness chromium
No. B 59 A	Ni, Cr	0.0002	0.00002	Brass bright dipped

Exposure Tests:

Specimens of the sets shown in Tables I, II and III have just been exposed at Key West, Fla., New York City, Pittsburgh Pa., Sandy Hook, N. J., State College, Pa., and Washington, D. C. In Pittsburgh the racks have been moved from Brunot Island to the U. S. Bureau of Mines to obtain a less severe, but still industrial, location. Certain of the original specimens that were still in fair condition have been retained in each location.

Inspections will be made by members of the Joint Committee and other interested persons, who may secure a schedule from the chairman. As soon as the results warrant definite conclusions or recommendations, these will be published.

The committee desires to thank those firms that have donated materials or equipment for this investigation and those persons who have assisted in the inspections.

Respectfully submitted on behalf of the Joint Committee,

W. BLUM,
Chairman.

TABLE III.—Coatings on Zinc Die Castings

Set	Die Casting	Coating	Coating Thickness, in.			Variation
			Copper	Nickel	Chromium	
No. Z 22 A	No. XXIII	Ni (HS), Cr	-------	0.0005	0.00002	Thickness nickel
No. Z 24 A	No. XXIII	Ni (HS), Cr	-------	0.0003	0.00002	Thickness nickel
No. Z 35 A	No. XXIII	Ni (HS), Ni (S), Cr	-------	0.0003 0.0002	0.00002	"Duplex" nickel
No. Z 37 A	No. XXIII	Ni (HS), Ni (S), Cr	-------	0.0003 0.0007	0.00002	Thickness duplex nickel
No. Z 38 A	No. XXIII	Ni (HS), Ni (S), Cr	-------	0.0003 0.0017	0.00002	Thickness duplex nickel
No. Z 40 A	No. XXIII	Cu (Cy), Ni (S), Cr	0.0002	0.0003	0.00002	Copper layer
No. Z 41 A	No. XXIII	Cu (Cy), Ni (S), Cr	0.0004	0.0006	0.00002	Thickness copper layer
No. Z 42 A	No. XXIII	Cu (Cy), Ni (S), Cr	0.0005	0.0015	0.00002	Thickness copper layer
No. Z 48 A	No. XXIII	Ni (HS), Cr	-------	0.0002	0.00002	Thickness nickel
No. Z 51 A	No. XXIII	Ni (HS), Cr	-------	0.00075	0.00002	Thickness nickel
No. Z 52 A	No. XXIII	Ni (HS), Ni (S), Cr	-------	0.0003 0.00045	0.00002	Standard, duplex nickel
No. Z 53 A	No. XXIII	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Standard, copper, nickel
No. Z 53 B	No. XXIII	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Bright nickel
No. Z 53 E	No. XXIII	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Bright nickel In commercial plant
No. Z 53 G	No. XXIII	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Bright nickel In commercial plant
No. Z 53 H	No. XXIII	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Bright nickel In commercial plant
No. Z 54 A	No. XXIII	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00001	Thickness chromium
No. Z 55 A	No. XXIII	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00003	Thickness chromium
No. Z 56 A	No. XXIII	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00005	Thickness chromium
No. Z 61 A	No. XXI	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Like Z 53 A, different alloy
No. Z 61 B	No. XXI	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Bright nickel
No. Z 61 E	No. XXI	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Bright nickel In commercial plant
No. Z 61 G	No. XXI	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Bright nickel In commercial plant
No. Z 61 H	No. XXI	Cu (Cy), Ni (S), Cr	0.00025	0.0005	0.00002	Bright nickel In commercial plant

Technical Control of Electroplating Processes

Control is absolutely necessary to economical operation. Various metal plates and the important factors to be controlled. Conclusion*.

By S. C. TAORMINA

Technical Director, Platers Research Co., Brooklyn, N. Y.

Nickel Solutions

Nickel solutions are not very critical. The most important factor is pH, the requirements for which, vary with the type of bath and the temperature. pH may be taken with a potentiometer, colorimetric standards, or by volumetric titration in terms of acid or ammonia. It is important to have enough boric acid in the bath at all times so that pH variations are not frequent or sharp. Hot nickel and bright nickel baths are more critical than the low metal cold baths. When the addition agent for a bright nickel bath can not be conveniently tested by chemical means, additions should be made on an ampere hour basis. The tendency in most nickel baths is for the pH to go up. Therefore, additions of safe amounts of acid may be made daily and pH thus checked every few days. Where the drag-out and plate-out are light in comparison with the total amount of solution in a bath, analyses of the metal content, chlorine, and boric acid may be made monthly or semi-monthly. Where the plate-out and drag-out are heavy in comparison with the volume of solution, analyses must be made at least once per week, and sometimes twice a week. Records should be kept of all additions made to all tanks. These records are valuable in determining what routine additions should be made and the time to make them. Eventually, the number of analyses may be cut down to a minimum.

In barrel plating the drag-out is high, and as a rule a certain amount of addition agent (brightener) is required at the end of the day. The tendency of the pH to go up is even greater than in still baths and a certain amount of sulphuric acid should be added daily. Metal and chlorides may be checked every other week. The loss of boric acid is proportional to the loss of chlorides; therefore, when replenishment of chlorides is made, boric acid may be added in proportionate amounts. This principle is also applicable where such salts as citrates and sulphates are used (die cast nickel solutions). No fixed time can be given for analyses. The main idea is to keep the bath at its highest efficiency according to the standards originally adopted.

The following are some formulae in general use:

Low Metal Bath

Nickel sulphate	12 oz./gal.
Ammonium chloride	2 oz./gal.
pH	6.0
Boric acid	2 oz./gal.

Nickel Barrel Plating Bath

Nickel sulphate	24 oz./gal.
Ammonium chloride	2½ oz./gal.
pH	6.0-6.2
Boric acid	2½ oz./gal.

Intermediate Bath

Nickel sulphate	20 oz./gal.
Ammonium chloride	3 oz./gal.
pH	5.8
Boric acid	3 oz./gal.

Nickel Electrotyping Bath

Nickel sulphate	10 oz./gal.
Ammonium chloride	¾ oz./gal.
pH	5.6

High Metal Bath

Nickel sulphate	34 oz./gal.
Nickel chloride	4 oz./gal.
pH	3-4 (hot)
pH	5.6 (cold)
Boric acid	4 oz./gal.

Nickel Bath for Die Castings

Nickel sulphate	8 oz./gal.
Ammonium chloride	2 oz./gal.
Sodium sulphate	12 oz./gal.
Sodium citrate	4 oz./gal.
pH	6.2
Boric acid	2 oz./gal.

Cyanide Baths

Cyanide baths offer considerably more difficulty in their control. The important baths are:

Copper	Zinc	Cadmium
Silver	Gold	Brass and Bronze

The standard to use should not be a matter of accident, and careful consideration must be given to the purpose of the bath.

Copper: There are several types of cyanide copper baths generally used, including the following:

Copper Strike for Cleaning:

Copper cyanide	1.0 to 2.0 oz./gal.
Free sodium cyanide	0.3 to 0.5 oz./gal.
Sodium carbonate	3.0 to 5.0 oz./gal.

This bath should be used hot and at as high a current density as possible. Plating time is only 30 to 60 seconds, and therefore, while a large tank is not necessary, it is important to check the free cyanide frequently as considerable is lost due to both drag-out and decomposition. Metal and carbonates should be analyzed about once a week.

Cold Regular Plating Copper Baths: A high metal bath is not only possible but advisable, if enough current is available to supply it. The formula suggested for this bath is:

Copper cyanide	6.0 oz./gal.
Free sodium cyanide	1.0 oz./gal.
Sodium carbonate	4.0 oz./gal.

This bath may be used at 25 amperes per sq. ft. It has a high cathode efficiency. The copper content should be kept high, and if the solution is used heavily the components should be checked once weekly.

*Part 1 was published in our July issue.

Hot, Regular Copper Plating Baths: The above bath may also be used hot. Since the bath has considerably more conductivity at high temperatures, the copper content may be cut down by 25%, thus cutting down drag-out losses. The free cyanide should be about 0.5 ounces per gallon. Temperature control, despite general negligence of this in practice, is very important. The temperature range is between 120° to 140° F. Free cyanide content should be checked daily; the metal content, weekly.

Brass and Bronze plating is generally a matter of color. Here analysis is doubly important. The color of a brass or bronze solution is most practically controlled by free cyanide content, and by temperatures and current density. A close balance in metal content is also necessary. We prefer copper anodes because brass anodes do not corrode in the same proportion of copper and zinc as originally used in the solution. If copper anodes are used, replenishments of zinc may be made periodically. Therefore, zinc content should be checked frequently. If brighteners are used, they may be added on an ampere-hour or production or time basis. The method of control is determined by convenience. Typical brass and bronze solution standards follow:

When Making up New Baths

	Still Brass Solutions	*Brass Barrel Solutions*	*Bronze Solutions*
Copper cyanide	4.5 ozs./gal.	6.0 ozs./gal.	4.5 ozs./gal.
Zinc cyanide	1.5 ozs./gal.	1.2 ozs./gal.	0.5 ozs./gal.
Sodium cyanide	7.5 ozs./gal.	1.2 ozs./gal.	0.5 ozs./gal.
Sodium carbonate	4.0 ozs./gal.	9.0 ozs./gal.	5.2 ozs./gal.
28% ammonia water	3.0 c.c./gal.	4.0 ozs./gal.	4.0 ozs./gal.

Composition by Analysis

	Still Brass Solutions	*Brass Barrel Solutions*	*Bronze Solutions*
Copper cyanide	4.5 ozs./gal.	6.0 ozs./gal.	4.5 ozs./gal.
Zinc cyanide	1.5 ozs./gal.	1.2 ozs./gal.	0.5 ozs./gal.
Free cyanide	1.5 ozs./gal.	2.0 ozs./gal.	0.4 ozs./gal.
Sodium carbonate	4.0 ozs./gal.	4.0 ozs./gal.	4.0 ozs./gal.

In barrel plating of both cyanide copper and brass solutions, the free cyanide content should be checked frequently, as that, more than any other factor, controls the nature and color of the plate.

Cadmium solutions present interesting control problems. The nature of the plate is not only influenced greatly by the current density, but also by the temperature, metal and free cyanide content; besides which, the brightener content plays an important role. If temperatures rise too high (as in barrel plating) dull plates result. If metal content decreases, conductivity decreases and the proper current density for optimum bright plates cannot be obtained. The same is true for both free cyanide and caustic soda content.

There are a number of standards used. However, these are usually determined by the various patented brighteners and processes. When a high metal cadmium bath (6 ozs./gal.) is used, then nickel sulphate and sulphonated castor oil are used as brighteners and high current densities are necessary. The free cyanide content should be controlled carefully. The brightener content in this case is not critical and is added to replace drag-out.

In the low metal baths (3 ozs./gal.) organic brighteners are exclusively used. The brightener content is more critical and additions are made on an ampere-hour basis. The free cyanide range is not as critical as in the higher metal baths. The caustic soda content here is more critical, however, than in high metal baths. As in all plating solutions and particularly in cyanide solutions, the current density is a very important factor as regards the efficiency of the bath. Constant current densities should be maintained. Cadmium tends to build up except in barrel plating baths. Therefore, steel anodes may be used in place of some of the cadmium anodes. The ratio of cadmium to steel anodes is a matter of experiment in each plant. If a tank is in constant operation with a heavy drag-out, no steel anodes are necessary. If it is not used heavily and the tendency of the cadmium is to go up, then a number of steel anodes are added until the cadmium content remains somewhere within a quarter of an ounce per gallon of the original standard in use.

Cyanide Zinc: Due to the shortage of cadmium in the last few years, new interest has been aroused in the zinc solution.

A number of patented and special cyanide zinc plating baths are on the market that are well worth utilizing. The old type of zinc cyanide baths had the disadvantage of rapidly oxidizing and discoloring. This served as a handicap as far as decorative plating was concerned. The newer baths and technique have overcome this obstacle and very attractive and rust-resisting finishes are now obtained.

However, these baths require rigid control. All the component factors are critical, besides which, the bath must be free of impurities. Addition agents must be used. Proper current densities must be maintained; metal content, free cyanide and caustic content must be kept within proper limits; addition agents must be replenished, preferably on the ampere-hour basis. Furthermore, this type of plate has an after-treatment, usually consisting of very dilute (½%) nitric acid.

Zinc content may be analyzed once weekly. For two or three weeks the zinc cyanide, free cyanide and caustic soda content should be checked daily until a schedule of additions may be determined. Zinc cyanide is not generally needed because the anode efficiency of the average cyanide zinc bath is high. But sodium cyanide and caustic soda must be added once weekly and sometimes twice weekly. In barrel plating, sodium cyanide and caustic soda additions may be required daily. The brightener is usually added daily in both still and barrel plating solutions. An excellent method of checking brightener content is to use the caustic soda content as a guide. There is a definite relationship between the caustic soda drag-out and the brightener drag-out and plate-out. But this must be determined in each individual plant. Replenishment of brighteners, however, is best made on the basis of ampere hours of electrolysis.

The solution used for brightening after plating should be changed at least daily and sometimes twice daily. Fortunately, this is not expensive. Rinse waters, both hot and cold, must be kept scrupulously free of foreign chemicals. Manufacturers who own patents and formula of the zinc

cyanide baths are very glad to cooperate with platers in developing the proper technique of plating. But the actual control is up to the plater, and if the means of analyzing and controlling this type of bath are not on hand, it is useless to attempt cyanide zinc plating and expect the results to be up to par.

Acid Copper baths are easily controlled, but it is a mistaken idea that they can be neglected. The chief difficulty encountered in acid copper baths is the introduction of iron, which causes rough and dark deposits, hard to buff. Therefore, the copper sulphate content should always be kept as high as possible so that the ratio of copper to metal impurity is high. One of the most frequent causes of trouble with acid copper solutions occurs in winter. Many plating tanks are located where weather conditions affect them. Tanks so located should be fitted with heating coils. Acid copper tanks should be operated at around 70° F. Streaky and other troublesome deposits are caused by operating them at 50° F. and lower.

Addition agents should not be used at all, or very sparingly.

A typical acid copper formula is:

Sulphuric acid	7 ozs./gal.
Copper sulphate	27 ozs./gal.

Silver solutions are perhaps the easiest to control. We have on record cases where only 90 ounces of silver cyanide per 100 gallons of solution were required over a period of one year. The most important factor in the control of silver plating baths is the original standard. With sufficient anode surface, hardly any silver cyanide addition is necessary. The only other factor is the free cyanide content. Small additions may be made weekly, depending upon production, and analysis for free cyanide once weekly or once every two weeks should suffice. A formula suggested is:

Silver cyanide	4.5 ozs./gal.
Free sodium cyanide	3.5 ozs./gal.
Sodium carbonate	4.0 ozs./gal.

Silver Strike solutions, however, are very important and their control very necessary. There are any number of standards, but the ratio between silver cyanide and free cyanide should be from 1 to 10 to 1 to 20. Strike solutions should be analyzed no less than once every two weeks for silver content, free cyanide and carbonates. A typical formula is:

Silver cyanide	0.3 ozs./gal.
Free sodium cyanide	5.0 ozs./gal.
Sodium carbonate	4.0 ozs./gal.

Cyanide Gold is not a very critical bath but on account of its high cost should be rigidly controlled. The gold anodes should be dried and weighed after each day's run. An ampere hour meter should be installed in the line and when bath efficiencies are determined, a proper check can be maintained on the amount of gold plated out and the amount remaining in the bath. Phosphates are lost by drag-out only and must be replaced on that basis.

Space does not permit going into further detail on many special solutions including cleaning solutions, anodizing and electrolytic coloring baths. The chief recommendation that can be made to any plater or individual in charge of electrolytic processes is that as long as the instruments of control are available, *by all means use them*, and the desired results will be easily, and more economically obtained.

Society for Testing Materials Features Work on Metals

The 41st Annual Meeting of the American Society for Testing Materials was held in Atlantic City, N. J., June 27-July 1st. The registered attendance of 1138 was a new high mark for Atlantic City. More than 225 committee meetings were held and 17 sessions were devoted to papers and reports.

During these meetings over 100 technical papers and reports were presented; 72 new tentative standards were approved, and 33 existing tentative specifications were approved for reference to letter ballot of the Society membership for adoption as formal standards.

The 1939 Annual Meeting will be held in Atlantic City together with the Fifth Exhibit of Testing Apparatus and Related Equipment. The 1939 Committee Week will be held in Columbus, Ohio, during the week of March 6-10.

The 13th Edgar Marburg Lecture on "*The Torsion Test*" by *Dr. Albert Sauveur* attracted a large audience. The 1938 Award of the *Charles B. Dudley Medal* was made to *R. H. Heyer*, member of the Research Department of the American Rolling Mill Company, for his paper presented at the 1937 annual meeting, "*Analysis of Brinell Hardness Test*".

New officers who were elected for the year 1938-1939 were: President—*T. G. Delbridge*, Atlantic Refining Co., Philadelphia, Pa.; Vice-President—*W. M. Barr*, Union Pacific Railroad Co., Omaha, Nebr., to serve with *H. H. Morgan*, Robert W. Hunt Co., who became vice-president in 1937.

Interesting sessions were held on the *Effect of Temperature* and *The Fatigue of Metals*. Another session of importance was devoted to *Radiography*. Committee E-7 is engaged in studies preliminary to the development of acceptable recommended standards and recommended practices covering radiographic examination.

The 16th session was devoted to *Non-Ferrous Metals* and *Spectrography*. Of major importance in the work of Committee B-3 on the Corrosion of Non-Ferrous Metals and Alloys was the report of Sub-Committee on *Atmospheric Corrosion*, giving the results of the three series of tests on 24 metals and alloys exposed since 1931 to various atmospheres at 9 test locations. The committee indicated that in view of the small losses of tensile properties experienced by many of the metals and alloys, it is still too early to attempt to rate them on the basis of their corrosion resistance or to predict their probable life in any atmosphere.

The *Joint Committee on Exposure Tests of Plating on the Non-Ferrous Metals* listed in its report the details of a large number of specimens which have just been exposed at various locations, giving data on coatings on steel, rolled high brass and zinc die castings. This report appears in full on page 372 of this issue.

Another valuable feature was the symposium on *Impact Testing* to which two sessions were devoted.

Fifty-Three Years as an Electroplater

Reminiscences of a retired pioneer, from the early days to the present. Part 2*.

By D. W. ROBINSON

Late Supervisor of Finishes, Remington Rand, Inc., Ilion, N. Y.

THIS was in 1887 and the *C. Cowles & Co.'s* plant was located right in the center of New Haven, the city having grown up around it. Some years later the plant was moved to its present location at Chestnut and Water Sts. I understand that in that plant today is one of the most up to date plating outfits now in operation.

At the old plant where I was employed I observed a kind of plating being done which I believe was fast dying out. It was called "close plating," and consisted of sweating pieces of brass or silver onto various parts of harness trim, etc., such as the names. The elderly man who did this work was very expert in fitting the pieces on and when the job was done it looked like one solid piece. It was then polished and I believe, would never wear out in use.

While I was employed at the coach lamp work I learned how to do a number of useful things: spinning, drawing mouldings for the plate glass windows on the lamps, soldering, and finally, making complete lamps.

Work on Casket Hardware

I never went back to my old job at *Elm City Mfg. Co.*, as I had a better place offered me with the *Grilley Co.* in New Haven, and went to plating there. This concern manufactured a nice line. One of their big jobs was silver plating steel screws and burnishing them. These were used very extensively on coffins and casket handles and trim. The Grilley Co. were also manufacturers of casket hardware in a small way. They were also making steel screws capped with brass, bronze or silver. These were used in railway passenger cars, etc.

Naturally, I was learning all of this time, getting practical experience and at the same time studying how to do better plating. In this connection, I was obliged to turn out perfect silver plating on screws; these screws were all burnished on the heads in small bench lathes. Bloodstone burnishing tools were used and the silver must stick and not peel. This I was required to accomplish by using a minimum amount of silver per gross of screws, strict account being kept of the silver used daily. I was able, while employed by Grilley, to make various improvements, both in plating and burnishing silver;

The late D. W. Robinson

also in nickel plating. This concern had been doing nickel plating right along and they had wooden shutters on plating room windows to prevent any one from looking in. I had here the Gore nickel solution and tor anodes, drop nickel in wicker baskets. This was done away with soon after I went there as the patents held by the U. S. Nickel Co. were expiring, I was told.

At this plant I had a Boissier dynamo which worked quite well, but it was necessary to keep a pail of water with a small rubber hose attached sitting on top of it, the water being to keep the fields cool. This dynamo was known as the horseshoe type. Other equipment was good and had been kept in good order.

I had continued my studies, having access to some French and German translations, also books such as Roseleur, Watts, Gore, etc. Wherever and whenever I could I did some experimental work, trying constantly to improve. I was employed at this plant from 1888 until the close of the year 1892.

In December, 1891 I was married although my wages were quite small, $16.50 per week of fifty-nine hours. I afterwards got a raise to $19.50 per week, which was then considered very good pay. Our manager was a stickler for keeping everything in order and encouraged any move which would produce more at a lessened cost.

A Bigger Job and No Comforts

In November 1892 I received a call to come to Hotel Taft to meet a Mr. Hamilton who was looking for a man to take charge of the plating department for the *N. C. Co.* at Allegheny City plant, then called *Hamilton, Lemmon and Arnold Co.* I believe he was favorably impressed by the superior quality of screws, etc. turned out by the *Grilley Co.*, and which his plant could not produce. In fact, I afterward discovered that many thousands of dollars had been spent by his company and a tremendous waste incurred. He had found out in some way that I was directly responsible for the plating and had come to New Haven to interview me. I told him I did not wish to leave New Haven for very good reasons, and especially to take a job as plater in a run down, out-of-order place.

*Part 1 was published in our April, 1938 issue.—Ed.

He then proposed that I come to Pittsburgh as manager of the small plant making casket hardware, etc. He drew up a contract covering a three-year period beginning with January 1893, which I finally signed. This contract specified salary of $25.00 for the first year, $27.50 for the second, and $30.00 the third year, all traveling and moving expense paid by the company. Had I realized what I was getting into I never would have signed that contract. It seemed then to be the thing to do.

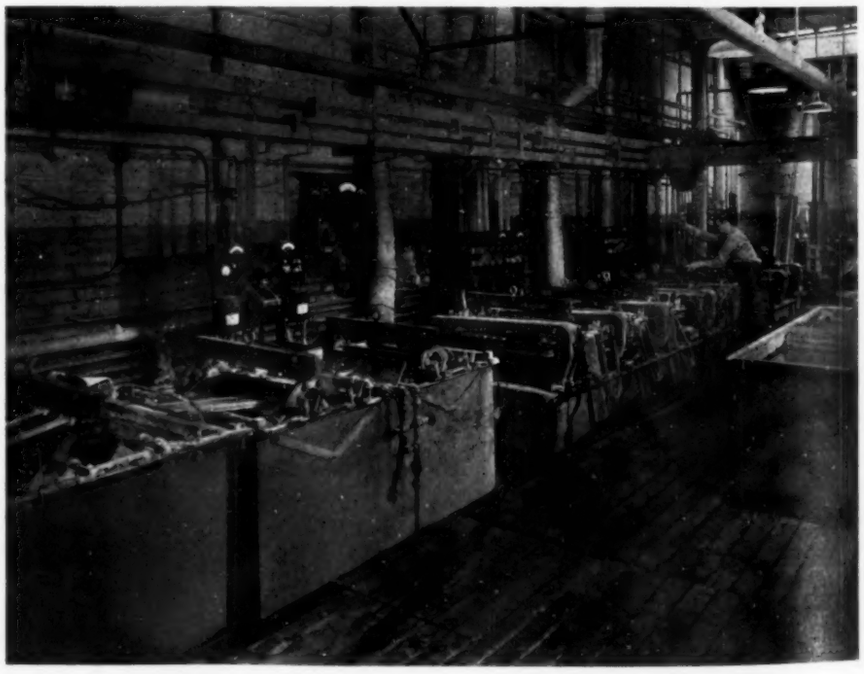
I left New Haven Dec. 31, 1892 and arrived in Pittsburgh that evening and went to a hotel for that night. Early the next morning I awoke and shook from my clothing the soot which had come in through the slightly opened window. After a bath and breakfast a man approached me and said that he had been sent to help me find a room and boarding place. I think that after going with him to some of the places which he seemed to think desirable or not too bad, I could have taken the train back to New Haven. I was so surprised and discouraged. A bed, a chair or two and very little else; some rooms with two beds and they were being occupied days by night workers and nights by day workers. The houses were dingy and sooty and there were very few places where board and room could be had together. It was almost too much for me. My guide seemed to think I was too fussy when I would not take any place which was offered. My New England bringing up would not stand for it. I finally was offered room and board with the plant engineer on a street not too far from the plant. The house was clean and well kept but not much like what I had been used to. No running water in the house, and no bath. A stand pipe in the paved court supplied water for a number of houses and a fine place to pass the time of day with the neighbors. I was up against it; could not get a decent drink of water and I could taste the disagreeable stuff in the food, coffee, etc. I felt squeamish all the time and finally bought distilled or bottled water when I could no longer stand it.

I had questioned Mrs. C., the landlady, about bathing facilities, and she assured me that her mother, just next door had a bath tub. All I had to do was to mention when and, "the tub would be ready, just step out one door and in the next, etc." I tried this but once was enough. The tub proved to be of wood, about six feet long, perhaps two feet wide and two feet deep. Water had to be carried to it after being heated. I found the natatorium on Penn. Ave. a place where I could get as good a bath as anywhere. As this story is being written it seems almost impossible to keep out of it numerous personal experiences which, I realize, were only incidental.

How a Plant Should Not Be Run

The work which I entered upon was quite familiar to me, with one exception, and that was the casting. But I soon became familiar with that. Mr. F. from Winsted, Conn. had charge of that and we got along finely as we had many ideas in common. I have never seen either before or since, such waste and bad working conditions as I found when I took over this job. I soon realized that I had tackled something which would tax my Yankee ideas to the limit. The worst thing, it seemed to me, was that everyone seemed to have become imbued with the idea that all the terrible waste and rejection was just something that had to be and could not be helped. It soon became evident that in most cases this waste was due to poor silver plating; also to the very careless and indifferent attitude of some of the help. Rather than do anything radical until I had become sure of my ground, I went into the plating department to see if I could get to the bottom of the trouble. Well, there was plenty of trouble. The plater, a man past middle age and his son, about eighteen years old, were almost the whole crew. They had a number of helpers, however. Mr. C. had come from Connecticut a number of years before, where he had worked in a place that did silver plating. He proved to me that he was very ignorant, but that was not all. He was never sober, kept himself full of whiskey, the son doing most of the work. I asked Mr. C. why they had so much bad work, bright work coming out dull, blistered, dirt not removed, left on from the sand buff, etc., causing an extremely large rejection, waste of time, waste of parts and also of silver.

"How do you determine what to do when your silver solutions do not work properly?" I asked. I was horrified to see him walk over to a silver tank, put his fingers into the solu-



Barrel plating department of the Cutler Hammer Co., Milwaukee, Wis. Production plating as it was not done in the "good old days".

tion, thence into his mouth, tasting it and then spitting it out. "That's how I tell," he said.

Well, what to do? I waited a few days and right after lunch one day went to see him again, but did not find him. I asked the son if his dad did not come to work. "Oh, yes," he said, "he is around somewhere." He was. I found him drunk and asleep in one of the bins where paper boxes were stored. I told the son to tell him when he took him out that night that he was fired.

I got a jolt too. Mr. H., my boss, wanted to know how we were going to get along. I said, "I will get a plater and in the meanwhile will carry on." Easier said than done! I sent to Meriden but no one seemed to want work in smoky Pittsburgh. I finally did get a man and I did get things going better after a while. I never had seen as much drinking and liquor brought into the factory. After pay day it was difficult to get out the work required.

I started to salvage some of the waste, such as melting down castings and recovering the metal for recasting, getting the silver separated. I never did get at the screws, of which there was what appeared to be tons, on which attempts had been made to silver plate, but without any success.

Of course, what induced me to take this position was the money. My wife did not want to go to Pittsburgh. We were expecting a baby too. It seemed as though everything piled up with so much work and responsibility. I was swinging the job all right but dared not leave it. I was called at night to go to the plant to finish parts, and once was called out of church on Sunday evening because there had been a mine disaster and they needed casket handles for the emergency.

Cadmium Solution

Q.—I am sending you a sample of my cadmium solution for analysis, as a check.

A.—The analysis of your solution shows:

Cadmium	3.18 ozs./gal.
Total sodium cyanide	10.2 ozs./gal.
Free cyanide	4.7 ozs./gal.

Normally, a higher free cyanide will give better results. The free cyanide can be as much as 9 ozs. per gallon.—G. B. H., Jr.

Brown Finish

Q.—We have a finish which calls for the following formula:

5 gal. water
6 lbs. hyposulphite of soda
2 lbs. lead acetate

We are using a 20 gal. crock with steam heat; lead pipe running through and to get the desired brown color, but it takes too long (five to ten minutes for the dip). We would like to find out just what is lacking in our operation in order to obtain quick darkening.

A.—This formula is normally considered as producing a blue color. The blue will change to various shades of brown but these are hard to control and will take some time to develop so that in direct answer to your question cannot offer any remedy for cutting down on time.

If you wish a brown finish suggest you investigate other methods of obtaining this. Many formulas are given in the Platers' Guidebook, obtainable from the METAL INDUSTRY.

—G. B. H., Jr.

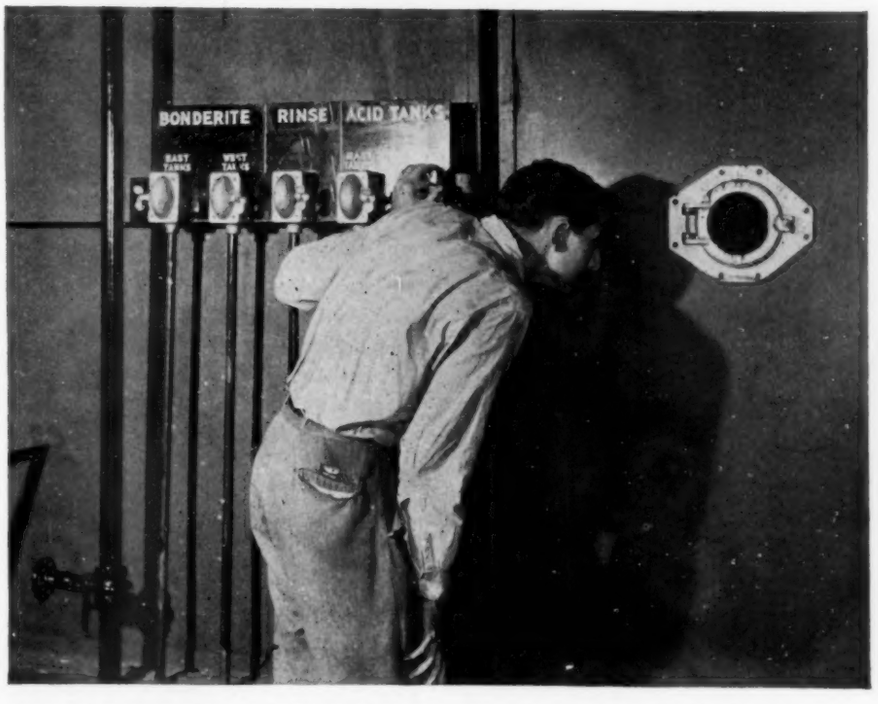
Water Spots

Q.—Please advise if brass articles coming out of a hot rinse and being placed into a chamber about 110° F. will not develop water spots.

Our work coming out of the hot water and air dried does develop such water spots. All our work is highly polished.

A.—In order to prevent water stains, the water must be removed by some means before drying. If articles are given a hot rinse and placed in a hot drying chamber as suggested, they will develop water stains. Spotless drying may be accomplished by using a clean cold water final rinse; then given a cold blast of air to drive off the excess moisture and then finally given a blast of clean hot air to evaporate the remaining moisture. By this method highly polished work may be dried free from spots and stains.—T. H. C.

Remote Control of Rust Proofing



Chemical solutions are held to close tolerances by chemist E. H. Diamond who watches over the efficient operation of the new spray Bonderizing system of the Buick Motor Company. Photo shows Diamond at the controls of the huge system while peering through one of the portholes that permit inspection of the interiors of the booths.

Lacquering Methods

Pointers for the man behind the spray gun about materials, methods and equipment.

By **E. M. STEPHENSON**
As told to G. B. Hogaboom, Jr.

LACQUERS are now such a common everyday essential of the metal finishing business that they are largely taken for granted, and the average user expects to obtain success with their use with as much confidence as he expects to obtain water from the faucet when the handle is turned. It has been only a few years, however, since industrial lacquers, and production methods for their application were introduced for general use.

In 1909 appeared one of the forerunners of present day lacquer spraying equipment. The device was crude and simple in the extreme but it contained the essential points of a method for applying lacquers that was to find universal application. The accompanying illustration shows two metal tubes placed at right angles. The end of the vertical tube is held beneath the surface of lacquer contained in a tea cup. Air was blown through the horizontal tube and the resulting suction drew up lacquer which was sprayed out at the end of the tube and directed at the work to be coated. Needless to say, the operator of this arrangement had his hands full, what with holding the air tube in one hand, the tea cup in the other and at the same time keeping one eye on the work and the other eye on the lacquer supply. There was no air regulation, and the volume of lacquer was small.

The first spray guns were introduced by Eureka. DeVilbiss added the first air control mechanism. Air pressures of 40 to 45 lbs. per square inch were used, as is the usual practice today. The distance from spraying to work is normally 8″ to 10″. A greater distance, up to 20″, will produce a pebbly effect and also cause peeling. Holding the gun too close to the work causes flooding and "curtains" will develop.

One of the important properties of lacquer to be used in spraying is the viscosity. The type of pigment used also influences viscosity. White is heavy, while yellow, blue, and red pigments float better. The weight of the pigment not only influences the spraying characteristics of the lacquer, requiring more or less air pressure, but also affects the covering power of the lacquer. Heavy colors tend to pebble and lighter colors will tend to thin out.

Proper care of spraying equipment is essential to the production of good work. The lacquer gun and container should be washed out with thinner as soon as the job is finished so as to keep the spray orifice clear. It is not advisable to immerse the whole gun in thinner as this removes the lubrication from moving parts.

Fig. 1. *The basic principle of the spray gun*

In using bronze lacquers only sufficient material is mixed for the job on hand due to the fact that an excess cannot be held for future use. Upon standing, the powder causes the lacquer to gel, and in addition, copper base powders will cause a green color to develop unless a special lacquer enamel is used containing metallic compounds that will not gel or turn green.

The proper maintenance of the spray booth is important from a saftey standpoint as well as the production of good work. The inside of the booth can be coated with a petroleum grease and so facilitate the removal of the lacquer coating which forms. Or, the booth can be lined with paper (which also may be greased) and the paper removed periodically. The paper lining method has the advantage that no scraping with a knife is necessary to remove the coating. A steel knife may cause spark which will result in fire. A turntable is generally used as it enables the operator to obtain even distribution. A mesh top is preferable to a solid top. The latter causes back pressure on the work and will destroy the lacquer film. Mesh allows the air to pass through.

Drying ovens should be well ventilated. If ventilation is not provided, or if vents become clogged due to carelessness a dangerous condition exists. Pressure due to vaporization of lacquer solvent will build up. When the door is opened a spark may occur which will ignite the vapors and cause an explosion. Many accidents have been caused by neglect to provide or maintain good ventilation on lacquer drying ovens.

If iron steam pipes are placed in the bottom of the oven they should be covered with a galvanized iron sheet. Then if a piece of work is dropped no spark will occur. This precaution is important as in many cases the pipes are grounded or connected in some way, perhaps accidentally, with an electrical circuit.

Many of the present day novelty finishes were discovered by accident. Thus during some experiments an attempt was being made to obtain a grey by first spraying a white followed by a black. A crackle was obtained instead. This was due to the fact that the white was slow drying

and the black was fast drying. The idea was further developed and became the basis of the present crackle finishes. Naphthalene in lacquer will produce a crystallized finish.

Special finishes can be obtained by certain manipulations and by the ingenuity of "the man behind the gun". Two-tone effects may be produced for example, by spraying the article with a shade of red and following this with a translucent blue clear lacquer. Different colors will show up depending on how the light strikes the surface. "Bleeding through" effects can be obtained by first spraying on a concentrated color. This will bleed through a subsequently applied lacquer enamel and give imitation marble, agate, or onyx coatings.

Floating enamels can be used to produce variegated colors by pouring, in streaks, a little of each color on the surface of the water in a tank. A stick (as for example a pencil) when passed through the partially mixed enamels will be coated with a marble-like coloring.

Fig. 2. E. M. Stephenson operating "the first spray gun."

Gold on Lead Base Alloy

Q.—Kindly give formula for duplicating sample of gold plated and finished casting and particulars as to preparation before gold plating.

A.—The sample submitted has been made of a lead base alloy, the alloy consisting of lead, antimony and tin.

In order to obtain finish as on sample, it is necessary to deposit prior to gold plating, a coating of bright yellow brass. This coating of brass gives a good base for subsequent gold plating. The color of the brass deposit will affect the color of the gold deposited, due to the fact that only a flash gold coating has been applied.

After brass plating, a flash of 24 K gold is applied and then finally lacquered with a clear metal lacquer to prevent tarnish.

The cleaner used prior to plating should be a mild alkali type to prevent undue tarnishing of the base metal.

The sequence of operations for finishing sample submitted can be set up as follows:

1. Casting: either die casting or slush casting; die casting to be preferred.

2. Removal of fins or gate by filing or by buffing if they are not too pronounced.

3. Clean in mild alkaline cleaner (no current).

4. Rinse in cold clean water.

5. Pickle in a 5 deg. Be sodium cyanide solution.

6. Rinse in cold clean water.

7. Bright brass plate for ½ to ¾ of an hour.

8. Rinse in cold clean water.

9. Flash gold 10 to 15 seconds in 24 K. gold solution.

10. Dry and lacquer.

The brass solution can be made up as follows:

Copper cyanide	3.6 ozs.
Zinc cyanide	1.2 ozs.
Sodium cyanide	7.5 ozs.
Sodium carbonate	4.0 ozs.
Water	1 gal.

Temperature 75-100 deg. F., current density 3-5 amps./sq. ft., voltage, 2-3 volts; anodes, brass—80% copper, 20% zinc; free cyanide, 2.5 ozs./gal.

One pint of ammonia added to each 100 gallons will aid in producing a good color when starting a new solution. It is possible to operate a brass solution at room temperature, but a more uniform and clear color will be obtained if the temperature is maintained at some point near 100 deg. F. It is absolutely essential if a uniform color is desired in the operation of a brass solution, to hold all conditions within reasonable limits constantly.

Arsenic is used as a brightener. Dissolve 2 lb. caustic soda in ½ gal. water and then add 1 lb. white arsenic. Use one fluid oz. in this solution to each 100 gallons of plating solution. An excess must be avoided as it will cause the anodes to burn black.

The 24 K. gold solution can be made up as follows:

Sodium gold cyanide	½ oz.
Sodium cyanide	½ to 1 oz.
Disodium phosphate	2 ozs.
Water	1 gal.

Temp. 140-160 deg. F., current density 1-5 amps./sq. ft., voltage 2½ volts; anodes 24 K. gold.

The color obtained from a cyanide gold solution can be made more yellow by increasing the free cyanide or the temperature or by lowering the current density. The nature of the basis metal will also affect the color of the gold deposit. Thus a gold flash over nickel or silver will have a lighter color than the same deposit made on copper, which latter will impart a reddish hue. In the same way the color of gold over brass will be affected by the color of the brass base, i.e., high or low brass.

In alloy gold plating, best results are obtained by using insoluble anodes and adding the necessary salts in the proper ratio.—T. H. C.

Distinguished Attendants at the Platers' Convention

Omitted for lack of space in our last issue, this snap-shot reveals Dr. Blum who is known to everyone in the plating industry and Dr. and Madame Huisman of Belgium; all "taking their ease."

Methods of Joining Copper Alloy Products. Part 7: Sheets

Welding methods have become vitally necessary (a) as an element in facilitating design, (b) as an economical manufacturing method, (c) as an aid to good service performance and (d) as a convenient means of making repairs. Examples are taken and analyzed to help the designer, shop superintendent and welding operator to a better understanding of the problems involved.*

By I. T. HOOK

Research Engineer, The American Brass Company, Waterbury, Connecticut

Bronze welding can often be done without the use of a back-up and oxy-acetylene fusion welding of copper, brass, "Everdur Silicon Bronze" and other alloys is often done without the use of a backer. A higher degree of skill is required in the absence of a backer than when one is used.

Figure 19 illustrates a simple back-up bar which may be used in the starting of a double vee weld or in controlling the metal in making a corner weld. A corner is machined from a square copper bar and used as indicated in (a) or (b) with the carbon or metallic arc. The bare copper bar would absorb too much heat

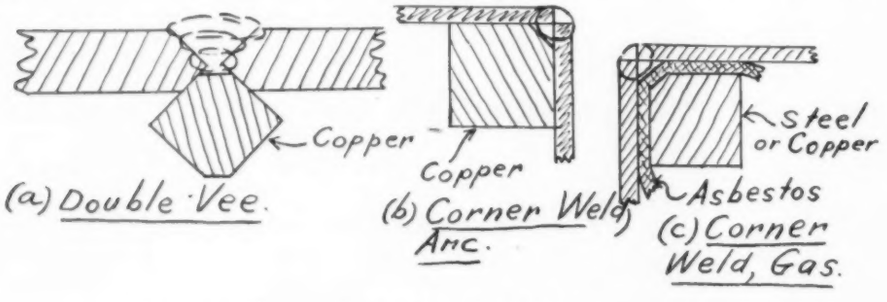


Figure 19. Copper backer for double Vee or corner weld.

were the bar to be used as in (a) or (b) for oxy-acetylene welds. For such welds, the set-up illustrated in Figure 19(c) would be preferred. Since the bar of (c) does not come in contact with the molten metal, a steel or cast iron bar may be used instead of copper. A wider flat on the corner is desired in order to make room for the asbestos sheet.

The large rectangular tank of Figure 20 is made up of ½" "Everdur Silicon Bronze" plate oxy-acetylene welded at the corners as indicated in Figure 19(c). A copper alloy was desired in this case as the return water from a large central heating system was quite corrosive and a corrosion resisting metal was required. The fillet welds securing the 5/16" Everdur plate baffles are carbon arc welded.

*Parts 1, 2, 3, 4, 5 and 6 were published in our issues for Sept., Oct., Nov., 1937, Jan., April and June, 1938.—Ed.

Fluxes†

As was explained in Parts 1 to 4, flux is generally desirable and often necessary to the securing of a strong joint. Zinc chloride solution is one of the several fluxes for soft solder. Where the copper or brass parts are tinned, a non-corrosive covering flux of resin or tallow may be used.

Such soft soldering fluxes can not be used for *silver soldering, brazing* or *welding*. A borax or boric acid base flux must be used. Common borax alone is rarely satisfactory for this purpose but mixtures of fused borax with boric acid are quite satisfactory for brazing. Such fluxes are often made up with admixtures of sodium chloride for copper welding and sodium or potassium fluoride for welding the copper-silicon alloys and for silver soldering. The addition of the fluoride or chloride is usually 10 to 20% of the fused borax-boric acid mixture.

The flux is often made into a thin paste with hot or cold water or alcohol and painted on the joint and the rod. Particularly in the oxy-acetylene welding of copper, "Everdur Silicon Bronze," brass and cupro-nickel and sometimes in the bronze welding of steel or cast iron, it will be found desirable to coat the welding rods rather liberally with flux. Brazing fluxes sprinkled dry upon the heated rods will stick in sufficient quantity to make dipping into the flux can unnecessary.

†Since publishing Part 6, a commercial flux has been brought to our attention that makes easy the hard soldering and brazing of beryllium copper. The Editor will be glad to furnish information on the source of this flux to interested readers.

Figure 20. Returned condensate storage tank made up of ½" "Everdur Silicon Bronze" plate. (Courtesy Whitlock Coil Pipe Co.)

Soft Soldering

Soft solders are not often used in joints calling for high mechanical strength and rightly so. Its role is rather (a) that of a metal-to-metal bonding agent as in electrical connections or (b) that of a sealing agent for riveted, lock-seamed or spot welded joints. However, where there is adequate soldered area, as in an automobile radiator for instance, it supplies sufficient strength to hold the thin copper or brass sheets securely together.

As was pointed out above, soft solder is the only metal bonding agent that, by reason of its low melting point, will complete the connection without danger of annealing the cold rolled copper or copper alloy sheet. Even this statement needs qualification. As for instance, pure copper is appreciably annealed at a temperature as low as 375°F. As will be seen from Table 2, the usual 50:50 lead-tin solder melts at 415°F and the usual solder bath is nearer 500°F. Also applications of the solder with a bunsen burner, gas-air, gasoline or acetylene-air torch is very likely to heat the base metal to 500°F or more. The cold work stiffness and strength can not, therefore, be retained in cold rolled sheet of pure copper. The same does not apply to brass or the other copper alloys as their annealing temperatures are higher.

Hence, a special copper is often used—in high duty heat exchangers for example—in apparatus which is to be soldered and in which the beneficial effects of cold rolling are desired in the finished product. The most effective copper to use for this purpose is a rather pure grade carrying .05% of silver (approximately 15 Troy ounce per short ton). Without suffering any appreciable loss in electrical and thermal conductivity due to this small addition of silver, the annealing temperature is nevertheless raised to approximately 620°F. Hence this silver bearing copper may be soft soldered without loss of its cold work strength and stiffness.

The usual deoxidized copper carrying no silver but with .05% phosphorus remaining in the copper also shows a decided improvement in the annealing temperature though the phosphorus is not as effective on this score as the same proportion of silver. Moreover, .05% phosphorus cuts the electrical conductivity of the phosphor deoxidized copper to only about 69% of that of the .05% silver-bearing copper, the thermal conductivities bearing very nearly the same relationship to the other.

Arsenic is also used to this end but much greater amounts must be used to have the same effect. Arsenical copper usually carries .50% arsenic which reduces the electrical (and thermal) conductivity of the resulting alloy to 38% of that of pure copper. Lake copper as a rule carries sufficient silver and arsenic to make it suitable for soft soldering without loss of cold work temper.

The sheer strength of a joint made in cold rolled copper, as illustrated in Figure 16, with the 50:50 lead-tin solders or the 95 tin, 5 antimony solder is very nearly 5,000 pounds per square inch when the test is made with reasonable speed at room temperature. But this figure is no criterion for designing a soldered joint that may have to carry a continuous stress —particularly if, as is often the case, the joint is at the same time enduring an elevated temperature as that from hot water or steam.

designers prefer to use bronze welded or silver brazed joints. However, numerous soft soldered copper tube and finned radiator installations have been made in the past ten years for both hot and cold water lines and little trouble has been experienced due to creep of the soft soldered joints.

Spelter Brazing, Silver Brazing

As will be inferred from the above, soft solder is properly used more as a metal-to-metal electrical bond, as a metal seal or for very light service stresses only. On the other hand, the brazing and bronze welding alloys of Table 3 are almost always used where the strength of the joint is of paramount importance.

In spelter or silver solder brazing, the lap or scarfed joints of Figure 16 are almost always used. Formerly a great deal of brass and high carbon steel tubing was made by the use of spelter solder applied to a tight, square-edged, butt, longitudinal seam. But in general, a bronze or fusion weld is to be preferred in a butt joint designed to take tension.

Since this is true the length of overlap, L, Figure 16(a) and (b) or the angle of scarf, Figure 16(c), must be

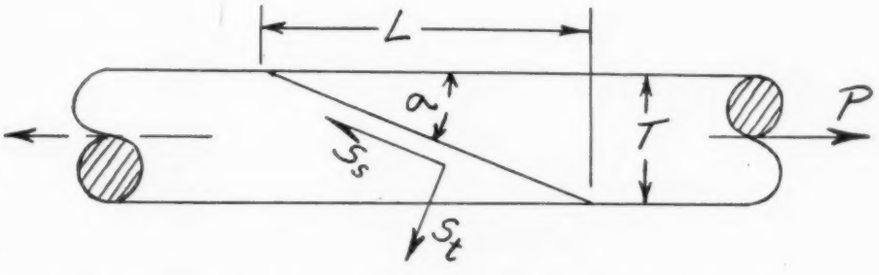


Figure 21. Stress on a brazed joint. S_s = Shear stress. S_t = Tensile stress.

Some tests on these two solders at *room temperature* (about 70°F) when used in shear on cold colled copper indicate a creep failure if the shear stress is continuously greater than 2,000 pounds per square inch for the 95 tin, 5 antimony solder and if it is more than 600 pounds per square inch for the 50 tin 50 lead solder. At the temperature of boiling water, 212°F, the corresponding values are 600 pounds per square inch and 200 pounds per square inch for the 95:5 tin-antimony solder and the 50:50 lead-tin solder respectively.

These values at first appear alarmingly low and, for this reason, many

stated. If the base metal is a copper alloy, the area of the brazed surfaces in shear should be two to three times the area of the right section of the sheet which takes tension.

A carefully made investigation into the strength of a silver brazed joint illustrated in Figure 21 showed that when a equals 45°, i.e. the brazed area being 1.42 times that of the right section*, the joint was liable to fail due to the combination of sheer and tensile stress imposed upon it by a

*The area of the scarfed joint equals area of right section/Sin. a. The length of the scarf L, equals the thickness or diameter, T times cotangent a. These relationships are equally true of rods and sheets.

longitudinal pull, P, on the rod. With a equals 30°, in which case the area of the scarfed surface is 2.0 times that of the right section better results were obtained and when the angle was 20°, making the area of scarf 2.92 times that of the right section, the joint developed the full strength of the annealed metal. While this investigation dealt with rods, the same proportions hold when the scarfed joint is in a sheet. The coppersmith understands this condition and rarely makes a scarf length less than three times the thickness of the sheet—corresponds to a scarf angle of 18½°, area equals 3.15 times that of the right section.

Referring again to Table 3, it will be noted that the first group are all high in phosphorus. Silver up to 14% is added to improve the flowing qualities and occasionally a small amount of tin. These solders are usable principally on copper and high copper alloys in joints that do not require any great amount of ductility—are not flexed, bent or worked after the joint is made. As might be expected, these high phosphorus solders melting at higher temperatures than soft solders, are able to withstand higher service temperatures without showing distress. Such high phosphorus solders should not be used to connect copper alloys to steel or cast iron. The joint will be too brittle by reason of the iron phosphide formed in the brazing operation.

The second group of Table 3 includes practically all of the commercial silver solders. The zinc, silver and cadmium all are more or less effective in lowering the melting point of the resulting alloy with copper. The function of the silver is to improve the flowing qualities without greatly lowering the strength of the solder. Since silver does not dissolve appreciably in solid copper, silver solders will penetrate long distances between closely lying copper or copper alloy surfaces. Silver solders may be used to join copper alloys to steel.

The third group of alloys in Table 3 are the spelter solders which are valued for their strength at the usual room temperatures and at moderately elevated temperatures. Owing to the fact that all of the constituents are soluble in hot solid copper, the spelter solders do not penetrate as far between overlapped copper surfaces as do the silver solders. The temperature of application is in general 200 to 300°F higher than is the case with the silver solders. The nickel constituent is only used when a white solder is desired. Tin lowers the melting point slightly but makes the spelter hard and brittle.

Furnace heating is often used in silver brazing and spelter brazing but more frequently a gas-air or an oxy-acetylene torch is used. For some purposes carbon resistors heated with an electrical current from a step-down transformer makes an excellent combination of heat and brazing pressure.

This series will be continued in an early issue.—Ed.

Cracked Copper Deposit

Q.—As a reader of METAL INDUSTRY, I would like you to make an analysis of the acid copper solution I am forwarding you as I am having a great deal of trouble with the copper shell cracking. I am also sending you a piece of the copper shell that was cut off the large copper shell that cracked.

I am making a heavy copper shell 47″ x 64″ filed smooth on back and filled with tinfoil. Then the shell is mounted and sweat on 5/16″ iron back with gas. This is used for embossing cloth and leather. The trouble I have is that the copper shell, after it is mounted on the iron back and ready for the nickel bath, shows small 2″ and 3″ cracks which show up very plainly after the nickel face is done and the plate is of no use as these cracks show in the cloth or leather after the embossing is done. What I would like to know is how to overcome this cracking in the copper shell.

A.—The analysis of the solution shows:

Copper sulphate	30.5	ozs./gal.
Sulphuric acid	7.56 av.	ozs./gal.

This solution is not in bad condition as far as the analysis for copper and acid shows, although an air agitated electrotyping solution can contain 33 ozs./gal. of copper sulphate and 10 av. ozs./gal. of sulphuric acid. Smaller crystal size is obtained with a higher acid content.

It is probable that the brittleness is due to the use of some organic material as a brightener, such as glue, dextrine, molasses, casein, or phenol-sulphonic acid. When these are present in excess brittleness often results. In such cases the quickest remedy is to remove a portion of the solution, add water and add the necessary copper sulphate and sulphuric acid to bring it up to strength. Electrolyzing the solution at a high current density using dummy cathodes will also often remove excess addition agents.

—G. B. H., Jr.

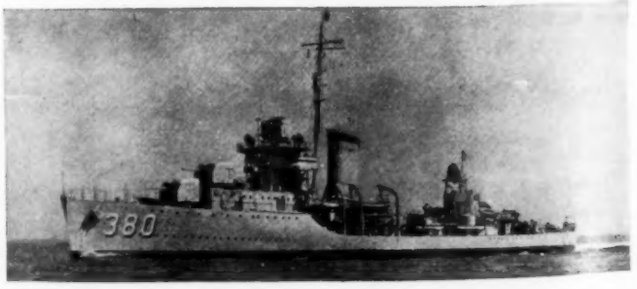
Stripping Steel from Copper

Q.—We have some very old solid copper engraved plates that have been steel plated. Can you tell us how to remove the steel plating without too much injury to the copper etching?

A.—The removal of steel which has been deposited on copper engraved plates can be accomplished by the use of a weak solution of hydrochloric acid. Copper is only very slightly soluble while steel or iron is readily soluble in this acid.

A 20% solution by volume with water heated to about 150 deg. F. should remove steel or iron coating readily without injury to the copper plate.—T. H. C.

Copper in the Navy



One of the greyhounds of the fleet, the Navy destroyer, U. S. S. Gridley Hull. Internally, a network of copper. (Courtesy, Copper & Brass Research Assn.)

Physical Properties and Uses of Heavy Nickel Deposits

Electrodeposition of heavy nickel layers is viewed as a cold casting process, capable of producing metallurgically sound nickel with excellent physical properties. The plating industry is already equipped to supply such a product for engineering uses and thus diversify and expand its business. Old and new engineering uses for thick nickel deposits are reviewed.*

By **W. A. WESLEY**
Research Chemist,
The International Nickel Company, Inc., Research Laboratory, Bayonne, N. J.

ELECTRODEPOSITION is generally considered only as a means of imparting non-rusting, bright surface finishes to improve the appearance of manufactured articles when new and during their useful life. There are other fields of work for which the electroplater is already equipped and which await more aggressive exploitation. These involve engineering uses, such as salvaging worn and mismachined parts, protecting parts against combined wear and corrosion, and the direct electroforming of finished metal shapes and parts. One sometimes hears predictions that organic and other finishes will eventually displace plated coatings and put electroplaters out of business. Exaggerated as such predictions undoubtedly are, they nevertheless have helped to spur the plating industry to accomplish great improvement in the quality of its products and should impel interest in everything which tends to broaden its field of usefulness.

In considering the possibilities of electrodeposition for uses outside the appearance field, it is instructive and permissible to look upon it as a cold process for casting metals. Every plater's shop contains the equipment needed for casting metallurgically sound metal, with physical properties better than those of the same metal in the ordinary furnace form, often equal to those of the wrought form, and sometimes with one or more properties superior to those attainable in any other available form. Hardness, faithful conformance to the surface of the mold, electrical and thermal conductivities are examples of properties in which electrolytic castings can excel.

Electrodeposition from the metallurgical standpoint is a cold process and, although it has its peculiar defects which must be avoided, it does not introduce the ill effects of heating, such as "weld decay", cracking by thermal stresses, softening with consequent loss of strength, nor hardening with loss of ductility. Why is it that electrodeposits are not used to a greater extent as engineering materials but are confined chiefly to use as thin surface finishes? One reason is that not enough study has been made of the physical properties of deposited metals. Another is that what is already known about them is not taught in schools. Electrodeposition has interested chiefly the chemist, who knows little about the structures, habits and uses of metals, while the metallurgist, who knows all about these things, has rarely seen a piece of electrodeposited metal strong enough to stand up alone.

Thickness of Deposits

The principal point of difference between electrodeposits employed for "appearance uses" and those for engineering uses is in the thickness. For reliable protection of steel against the atmosphere of coast and city one-thousandth of an inch of nickel is employed. High grade bumper bars for automobiles are provided with double this amount to protect against rusting even after severe mechanical damage or wear. Pores detectable by the ordinary tests disappear at about 0.002" so that heavier deposits behave like solid nickel.

The engineerng uses which will be discussed later, with few exceptions, require deposits of much greater thicknesses. 0.005 inch may be applied for resistance to corrosion and wear, while deposits of the order of 0.02 inch are used for reclaiming mismachined parts. "Cold castings" as thick as 0.2 inch have been applied in building up large worn shafts and in forming complete metal objects.

Hardness Ranges

One of the first things a metallurgist wants to know about a metal is its hardness because this classifies it and tells him something of the limits of its usefulness. Fig. 1 (p. 386) shows the ranges and hardness which have been reported for thick deposits of metals, according to Hothersall.[1] The highest values shown for a given metal are not in most cases commercially attainable due to the fact that they are generally accompanied by excessive brittleness and internal stress which lead to spontaneous cracking. Nevertheless, it is evident that an enormous range of hardnesses can be obtained in electrodeposits.

For practical purposes the range can be covered quite well by equipping the plating shop with only 4 plating baths, three of which are already present in almost every plant. These are listed in Table 1, (p. 386) the hard nickel bath being the only one not in common use today.

* Abstracted from a paper presented before a joint meeting of the American Society for Metals and the American Electro-Platers' Society chapters at Hartford, Conn. on April 12, 1938. This paper will appear in full in the August issue of the Monthly Review of the American Electro-Platers' Society.

[1] A. W. Hothersall, Metal Ind. (London) **48**, 115 (1936)

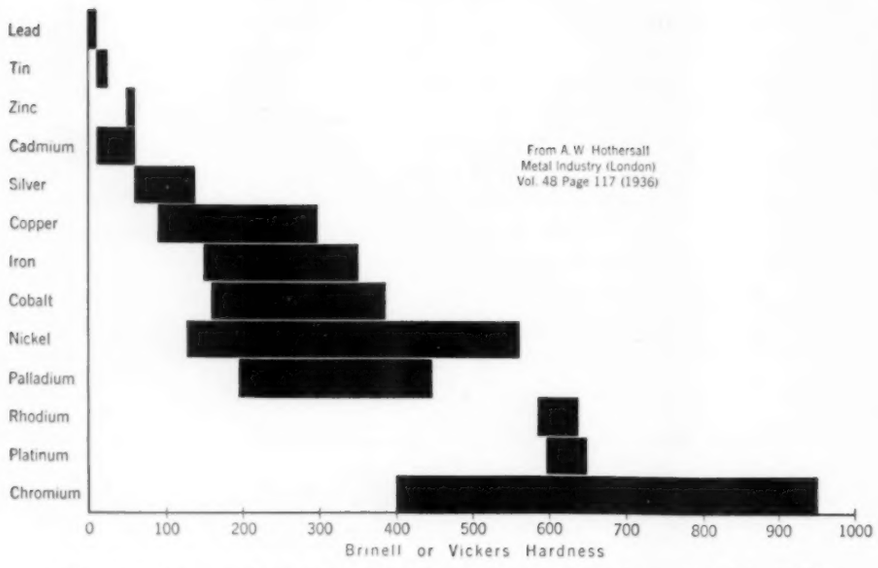


Fig. 1. *Ranges of hardness of electrodeposited metals reported in* 1935

TABLE I. FOUR BATH ELECTRO-FORMING SHOP

	Vickers Hardness
(1) Copper: Acid Bath	40—60
(2) Soft Nickel: Watts Bath	130—150
(3) Hard Nickel	350—450
(4) Chromium	500—900

Nickel Plating Conditions

Although Fescol, Ltd., the British firm which has specialized so successfully in "electrocasting", works its baths only at room temperatures and a relatively low rate of deposition, it is felt that the longer periods of time required to make heavy deposits would not be feasible in the United States.

Soft Nickel

The Watts type bath used for rapid deposition of thin deposits works equally well in building thick layers. At a temperature of 140° F. there is little difficulty in using a cathode current density of 50 amp. per sq. ft. without agitation. Suitable plating conditions are shown in Table II. At 50 amp. per sq. ft. about 0.0024 inch of nickel is deposited per hour so that 0.020 inch on the diameter of a shaft requires about 4½ hours plating time.

TABLE II. SOFT NICKEL PLATING

Solution:
- Nickel sulfate (crystals) 44 oz. per gal.
- Nickel chloride (crystals) 4 oz. per gal.
- Boric acid 4 oz. per gal.

Temperature:
- 140° F.

pH: 2.0 (Electrometric)

Current Density:
- 25-50 amp./sq. ft. (No agitation)
- 100 amp./sq. ft. (With agitation)

Hardness:
- 140-160 Vickers (10 Kg. load)

Rate:
- 0.0024 inch per hr. at 50 amp./sq. ft.

Hard Nickel

English investigators have led the way in the development of methods for depositing thick layers of relatively hard nickel. Macnaughtan and Hothersall[2] showed that the presence of ammonium sulfate in nickel plating solutions permits formation of sound nickel deposits of much higher hardness than could be produced in baths containing other addition agents. Very little work has been done on this problem in other countries.

Experimental work in the International Nickel Company's laboratory showed that hard nickel deposits can be produced at quite high rates. One set of conditions for this is shown in Table III.

The most recent work in this laboratory indicates that a solution containing a higher chloride content than that in Table III yields about the same hardnesses, yet gives better anode corrosion at high current densities and easier control of pH. The following composition seems most promising at the present time:

Nickel sulfate (crystals)	16 oz. per gal.
Ammonium chloride	2.3 oz. per gal.
Potassium chloride	1.1 oz. per gal.

Operating conditions are the same as in Table III.

The hardest deposits, if plated in thicknesses greater than about 0.02 inch, do show a tendency to form laminations and develop cracks. Where such hardnesses are required in very thick deposits a better product is usually obtained by building-up with tough nickel of more moderate hardness and finishing with hard nickel or chromium.

Structure and Physical Properties of Nickel Deposits

In order to compare the structures of electrodeposits with other forms of nickel, photomicrographs of a nickel casting and of commercial hot-rolled nickel are shown in Figures 2 and 3,

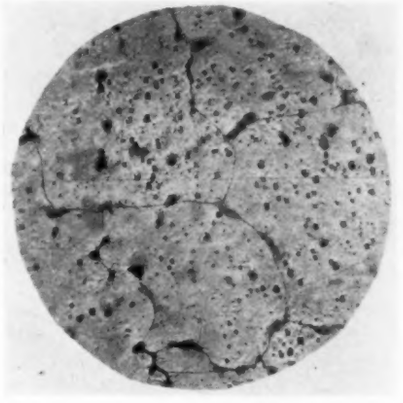


Fig. 2. *Structure of cast nickel* x100

originally photographed at 100 diameters magnification. The grains are more or less equi-axed and in-

[2]Macnaughtan and Hothersall, Trans. Farad. Soc. **24**, 387 (1928).

TABLE III. HARD NICKEL PLATING

Solution:	Nickel sulfate (crystals) 16 oz. per gal. Ammonium Sulfate 2.8 oz. per gal. Potassium Chloride 1.1 oz. per gal.
Temperature:	120-130° F.
pH:	5.2—5.8 (Electrometric)
Rate:	

Current Density (amp./sq. ft.)	*Hardness* (Vickers)
Without agitation:	
20	350—400
35	400—450
With agitation	
25	350—400
50	400—450

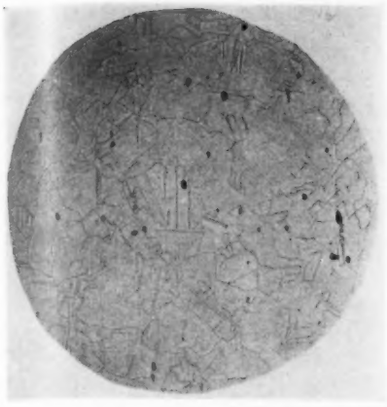


Fig. 3. Structure of hot rolled nickel x100

clusions are visible at this magnification. The illustrations of the structures of electrodeposit which follow these were made at 500 diameters because the grain sizes involved are so small.

Soft electrodeposited nickel is shown in Figure 4. There is a pronounced fibrous structure with the grains elongated in the direction of

Fig. 4. Structure of soft nickel deposit x500. T.S. — 51,000; El. — 28%; Vickers hardness—150.

growth, that is, perpendicular to the surface of the base. Electrodeposits with a structure like this are generally considered to have a preferred crystallographic orientation in a direction normal to the base. The existence of this can be established only by X-ray examination, since the mere fact that the grains are elongated in one direction does not prove that there is a preferred orientation. As a matter of fact, a thin deposit (0.001 inch) made under the same conditions as the nickel of Figure 4 did show a strongly preferred mixed orientation with both (100) and (122) directions normal to the surface.[2a]

[2a] Carl H. Samans, Private communication.

The tensile properties shown in Figure 4 were obtained with test-pieces "across the grain", that is, at right angles to the long direction of the grains. The values for tensile strength and elongation in other directions would probably be higher. The actual thickness of deposit tested was 0.023 inch. The freedom from large inclusions is noteworthy.

Figure 5 illustrates how much finer the grain size is in an even moder-

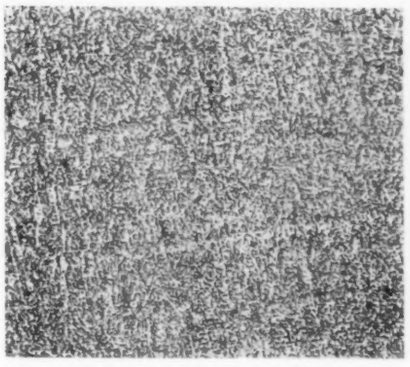


Fig. 5. Structure of moderately hard nickel x500. T.S.—98,000; El.—21%; Vickers hardness—230.

ately hard nickel, together with the loss of the fibrous structure. Deposits like this and the hard one which follows showed random orientation.[2a]

In a considerably harder deposit, such as that shown in Figure 6, it becomes

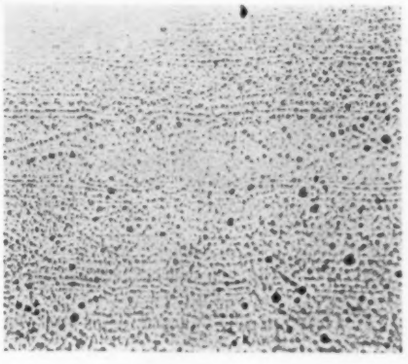


Fig. 6. Structure of hard nickel deposit x500. T.S.—132,000; El.—1%; Vickers hardness—360.

difficult to delineate any structure at all, the grain size becoming sub-microscopic. It was necessary to apply the etching reagent (cold concentrated nitric acid) much longer to this deposit than to the others to show anything at all. Due to a pitting action of the reagent at points which were probably microscopic inclusions, traces of a laminated structure are visible in Figure 6. This is a forerunner of the real laminations which become troublesome in deposits above 450 hardness.

The tensile properties of electrodeposits, the actual structures of which have just been illustrated, are compared with those of other forms of nickel in Table IV.

It will be seen that the values for the electrodeposits indicate that they are metallurgically sound metal and that the process of making them can well be called "cold casting". Similar data reported by Gardam and Macnaughtan[3] are shown in Figure 7.

[3] Gardam and Macnaughtan, Trans. Farad. Soc. **29**, 755 (1933)

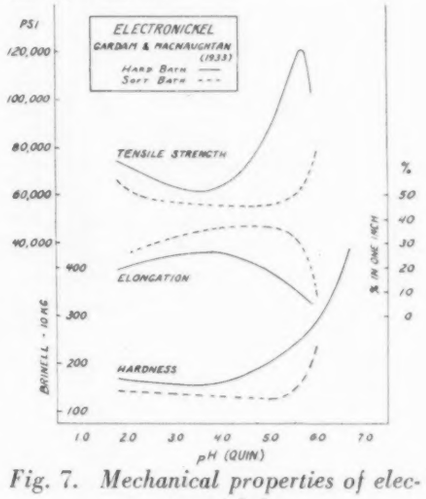


Fig. 7. Mechanical properties of electro-nickel

	Hard Bath	Soft Bath
Nickel sulfate: g.p. l	120	210
Nickel chloride: g.p. l	...	30
Boric acid: g.p. l	...	30
Ammonium sulfate: g.p. l	8	...
Potassium chloride: g.p .l	21	...
Temperature: °C.	35°	35°
Current density: amps./sq. ft.	11	11

TABLE IV. MECHANICAL PROPERTIES OF NICKEL

Form	*Hardness* V=Vickers B=Brinell	*Tensile Strength*	*Elongation* % 2 *inches*
Cold-Rolled, Annealed	100-130(B)	65,000-75,000	45-50
Cold-Rolled, Hard	180-230(B)	90,000-105,000	15-30
Castings	80-125(B)	55,000-70,000	15-30
Soft Electro	150 (V)	51,000	28
Medium Electro	230 (V)	98,900	21
Hard Electro	360 (V)	132,000	1

They indicate that, for the current density and temperature used by the Englishmen, maximum ductility in soft nickel is obtained at hydrogen ion concentrations in the pH range 4.0 to 5.5, the elongation being as high as 37 per cent in one inch.

Further evidence of the soundness of nickel deposits is to be found in the following measurements of density:

TABLE V. DENSITY OF NICKEL

Form	*Density at 23° C.*
Cold-rolled sheet	8.86
Soft electro	8.86
Moderately hard electro	8.91
Hard electro	8.89

Theory of Hardness

The fact that electrodeposits can be prepared of much higher hardness than that of wrought forms of the same metals has intrigued many investigators. The time-honored theory that the hardness is due to the presence of hydrogen as a hydride or in solid solution still has many adherents. The principal support for this theory is that the metals which show the most pronounced differences between hardnesses in the wrought and electrodeposited forms are also those which show the highest capacities to dissolve atomic hydrogen at room temperatures. Such metals are iron, cobalt, nickel, chromium and palladium. In addition, the hard deposits of some of these metals have lower softening temperatures than do their commercial wrought forms.

The principal evidence against the hydrogen theory is the following:

(1) About 90 per cent of the hydrogen present in electrodeposits can be removed by warming the metals in a vacuum without appreciable softening.[4]

(2) There is a poor correlation between the hydrogen content of nickel deposits and their hardness.[5]

(3) There is always a close correlation between grain size and hardness—the harder the deposit, the finer the grain.[6]

(4) Upon annealing hard deposits at high temperatures, non-metallic inclusions become visible under the microscope in amounts which increase with increase in the initial hardness.

[4]Guichard, Clausmann, Billon and Lanthony, Compt. rend. **196,** 1660, (1933)
[5]A. Brenner, J. Res. Nat. Bur. Stand. **18,** 565 (1937)
[6]Macnaughtan and Hammond, Trans. Farad. Soc. **27,** 633 (1931)

Macnaughtan, Gardam and Hammond[7] suggested that the hardness is due to the extremely fine grain size and that, in turn, is caused by interference with crystal growth exerted by colloidal nickel hydroxide or other basic compounds which are precipitated in the film of solution on the cathode surface and are occluded in the deposit. Desch suggested to Macnaughtan an additional idea which appeals to metallurgists, namely, that the hardness is not controlled solely by grain sizes but may also be increased by the presence of the non-metallic particles in a critical state of dispersion. These interfere with slip and cause hardness of the type developed in precipitation-hardened alloys such as Duralumin.

[7]Macnaughtan, Gardam and Hammond, Trans. Farad. Soc. **29,** 279 (1933)

Effect of Temperature

Hard nickel deposits have a lower softening temperature than wrought nickel. This is to be expected because the electrodeposits are not only quite pure, as compared with commercial nickel, but also are extremely fine-grained and are in a condition of high internal stress. The table below shows the effects of temperature upon the hardness (Vickers) of nickel coatings.

From these results it can be concluded that nickel deposits can be counted upon to retain high hardness of the range 300 to 450 at temperatures below 500° F.

At ordinary temperatures such deposits retain their hardness indefinitely, just as does chromium. Nickel of 470 Vickers, made in 1934, still shows the same hardness today.

Initial Hardness	*Time hrs.*	*Temp. °F.*	*Final Hardness*
325	18	400	295
325	1 week	400	295
325	18	500	295
470	24	500	400-450
475	4	600	222
445	4	600	380

This paper will be concluded in an early issue.—Ed.

Stripping Nickel

Q.—We enclose a steel strip which has been nickel plated and the nickel has peeled off in spots. We have quite a number of these strips, and would like to remove the nickel.

The strips come straightened out, whereas the sample has been bent for convenience in mailing, and they are rather delicate for tumbling without putting them out of shape. We have tried pickling them in dilute solution of nitric acid, but in places where the nickel was removed, the acid burned the steel.

A.—This can be done by immersing the parts in concentrated nitric acid. Keep moisture out of the acid as when it becomes dilute the steel will be attacked. For least attack on the steel use fuming nitric acid.

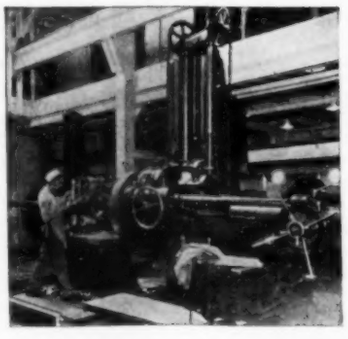
The pieces can also be stripped by making them anode in:

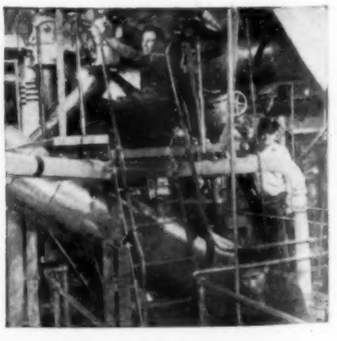
Sulphuric acid	2 gals.
Glycerine	2 ozs.
Water	1 quart

Use 6 volts, lead cathodes.

The action will be faster if more water is used but the attack on the steel will be increased.—G. B. H., Jr.

Copper and Brass in the Navy





Machine Shop, U.S.S. Medusa and Engine Room, U.S.S. Indianapolis
Courtesy, Copper & Brass Research Assn.

Shop Problems CASTING • METALLURGICAL FABRICATION • ASSEMBLING • • PLATING • FINISHING

Questions from readers relating to shop practice and answers by our associate editors

Barrel Nickel

Q.—We are sending you herewith some samples of parts which we are getting ready to plate. To start with we have never done any of this work before, and are trying to learn same from books, and get some advice from platers here.

The following were dissolved for an original solution:—175 No. single nickel salts; 30 No. nickel chloride; 30 No. boric acid. After we had plated some scrap pieces for a day, and the solution was about three days old an analysis showed metallic nickel 5 oz./gal.; chloride 1.0 oz./gal.; boric acid 3.0 oz./gal.; pH below 5.2. We then added 15 No. of sodium chloride in an effort to raise the chloride. After plating some more scrap pieces while getting things arranged the solution now shows the following composition—

Metallic nickel	5.0 oz./gal.
Chloride	2.3 oz./gal.
pH	6.2

We place 300 of these pieces in a barrel 12″ x 36″, and at 8 volts get an ampere reading of 61, and as our instructions call for from 4 to 5 volts we were wondering where our trouble lies. Changing rheostat to 4 volts reduces amps. to 30.

Also this is supposed to be a bright nickel job, instead of the white color which we get.

On the small parts enclosed herewith you will note about every color of the rainbow. This yellow and blue color sometimes shows up on the larger pieces also. Will you please advise the cause of same. You will notice that this color rubs off rather easily.

For cleaning we use a commercial cleaner solution, burnish with balls, and new clean water before plating; also a hydrochloric acid dip; after plating, into cold water, hot water, then dried in a centrifugal dryer. Is there any certain length of time pieces should be left in hydrochloric acid pickle?

A.—The discoloration on the parts is due to not having a sufficient thickness of nickel. The steel is rusting through the deposit.

If steel parts do not receive the deposit fast enough in barrel nickel plating, the metal is attacked by the solution and a coating produced that retards the subsequent deposition of nickel. It is important to deposit the nickel uniformly and readily after the parts have been placed in the barrel to prevent the above action. To do this requires that the work receive sufficient current. It must be remembered that much of the current goes to the contacts.

The current can be increased by raising the voltage or by increasing the anode area. Make sure that anodes

Use this Blank for Solution Analysis Information

Fill in all items if possible.

Date .....

Name ..... Class of work being plated: .....
Address ..... City ..... State ..... Volume used: .....
Employed by: ..... Solution depth: .....
Kind of solution: ..... Cathode surface, sq. ft.: .....
Tank length: ..... width: ..... Kind of anodes: .....
Anode surface, sq. ft.: ..... Distance from cathode ..... Original formula of solution: .....

REMARKS: Describe trouble completely. Give cleaning methods employed. Send small sample of work showing defect if possible.

Use separate sheet if necessary. _____

NOTE: **Before taking sample of solution, bring it to proper operating level with water; stir thoroughly; take sample in 2 or 3 oz. clean bottle; label bottle with name of solution and name of sender. PACK IT PROPERLY and mail to METAL INDUSTRY, 116 John Street, New York City.**

now in tank are clean. Clean off barrel contacts from excessive nickel if necessary.

To obtain a bright nickel the surface of the steel must be bright. This can be obtained on parts submitted by ball burnishing. Also, a nickel brightener must be used in the solution. For suppliers consult advertisers of same in the METAL INDUSTRY.

The length of time in the muriatic pickle need be only 10 to 30 seconds if steel is clean and free from rust. If pieces are rusty immerse until rust is removed.—G. B. H. Jr., Problem 5,671.

Adherence of Copper to Steel

Q.—I am operating an electrolytic copper plating plant in which I am depositing about .060" of copper on steel. This copper is deposited from a so called acid bath after first plating a thin coating of copper on the steel in a cyanide bath. It is necessary for my purposes to have an extremely strong bond between the copper and the steel and this I obtain very satisfactorily in my present practice.

It is my purpose to inquire whether or not there are any commercial processes in use whereby an equally good bond can be obtained without the use of the cyanide bath, which I would like to eliminate if possible so as to simplify my flow sheet.

I shall appreciate any information or references you can furnish me along these lines.

A.—It is quite necessary to first deposit a copper coating from a cyanide solution before depositing copper from an acid bath on steel. As far as is known no other satisfactory method has been devised to date to eliminate double plating. The problem of preventing the attack of the acid copper solution on steel has been a very difficult one to overcome.

—T. H. C., Problem 5,672.

Bright Zinc Deposit

Q.—Under separate cover, the writer is forwarding to you two samples of plated hinges—one in bright finish and one dull.

These finishes are produced as a substitute for, or an imitation of, chrome plate. I know that both are a zinc base with cadmium; also that both these are as they come out of the tanks, no brushing or buffing.

A.—The finish on these hinges has been tested and gives evidence of being a bright zinc deposit.

The base metal in both cases is steel.

The satin finished hinge is obtained by using a greaseless composition on a rag wheel. Such compostions are advertised in the METAL INDUSTRY.

The hinge in bright finish has been given a light buffing to bring up some color.

In either case, the finish of the steel is important and in buying metal for this work the desired finish should be specified to the supplier of steel sheet.

There are several advertisers in the METAL INDUSTRY who sell bright zinc plating solutions and processes.

—G. B. H. Jr., Problem 5,673.

Cleaning Electrical Connections

Q.—I have the problem of cleaning brass and copper electrical connections in a hurry. I would like to have a solution safe and convenient to carry around in a bottle to do this. The dirt consists of transformer oil oxide, scale, grease and oil. What would you recommend?

A.—Steel wool would seem to be the most convenient material to use in this case. Otherwise two solutions are necessary. The first is an organic solvent such as carbon tetrachloride or trichlorethylene, or naphtha or gasoline which are flammable and therefore less desirable. This will remove the oil and grease. The scale and oxide can be removed by the use of a solution consisting of 12 oz./gal. of sulfuric acid and 4 oz./gal. of sodium dichromate. It will take some time for this to act, especially since it is used cold in your case.

It is suggested that you try one of the newer combinations of solvent and phosphoric acid such as:

Phosphoric acid	1 volume
Ethyl alcohol	1 volume
Water	1½ volume
Isopropyl ether	1-5%

You can use another solvent instead of the alcohol.—G. B. H. Jr., Problem 5,674.

Cleaning Lead Base Work

Q.—We are making souvenirs and novelties, some of these are made of 85% lead and 15% antimony and are then bright copper plated, rinsed, dried and lacquered; (copper finished souvenirs). Our solution is a commercial bright copper made up exactly as the instructions call for.

Your advice of using a mild alkaline cleaner hot at 6 volts for the lead and antimony castings is being tried out ahead of our bright copper plating solution. Castings are left in from ½ to 3 minutes on different tests but work comes out bright just in spots although on leaving the electric cleaner, castings are bright all over.

Do you advise an acid dip to remove a possible oxide left on castings from the cleaner? If so please give your formula.

A.—A correct cleaning cycle for this type of work involves a direct current cleaning in a mild alkaline cleaner for about 15 seconds after which the articles are rinsed in water and given an acid dip to remove the film. A good acid dip contains 1 part of muriatic acid to 4 parts of water and the work should be given only a momentary dip until the bright finish begins to take on a slightly dulled appearance.

If after this procedure is followed the copper deposit is still spotty we would suggest that you investigate the condition of the bright copper which may be out of balance.

—G. B. H. Jr., Problem 5,675.

Cleaning Plumbing Fixtures

Q.—I am refinishing flushometers which are badly corroded. How can I get them clean so that they will take a good nickel and chromium plate?

A.—First put them through a mild alkaline cleaner; then dip them in a 10% sulphuric acid pickle which should take off most of the scale, dirt, etc. Then cold rinse and put through the cleaner again. It may be necessary after this step to do some hand-scrubbing if the dirt is deep in the crevices. Then bright dip in a mixture of 1 part nitric acid, 1 part sulphuric acid, 1 part water by volume. Afterward rinse in cold water, dry, then polish and plate in the regular routine.—G. B. H. Jr., Problem 5,676.

Metal Casting Digest

Short abstracts of articles of interest to practical non-ferrous foundrymen and metallurgists

By H. M. ST. JOHN
Associate Editor

Use of Scrap in the Manufacture of Non-Ferrous Metals. J. A. A. Fraser. Metal Ind. (London), Oct. 1st, 1937, page 329.

Economy demands the use of secondary metals. Methods of preparation of scrap materials must be of such a degree of thoroughness that increasing quantities can be incorporated in the melt without detrimental increase of impurities in the resultant casting. The author considers these methods in some detail.

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Metal Refining with Sodium Carbonate. Anon. Metal Ind. (London), Oct. 1st, 1937, page 334.

The use of sodium carbonate fluxes as a refining agent in the foundry is discussed with respect to copper, brass and bronze, nickel silver, and aluminum-silicon alloys.

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Production of an Aluminum Container. E. Longden. Metal Ind. (London), Oct. 8th, 1937, page 365.

Describes the technique employed in producing an aluminum vessel 32 in. long by 24 in. maximum diameter, having a wall thickness of 3/16 in.

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Copper Alloys as Bearing Metals, D. P. C. Neave and W. B. Sallitt. Metal Ind. (London), Oct. 15th, 1937, page 377.

Copper-tin bronzes; alpha-tin bronzes; tin bronzes containing chromium; alpha-delta duplex bronzes; phosphor bronze and deoxidation; scope of the rigid bronzes; leaded copper-tin bronzes; leaded alpha-tin bronzes and plastic bronzes; bronzes for high rubbing speeds; copper-lead bearings; powder-moulded copper-tin bearings; brass and manganese bronze; aluminum bronze; beryllium copper; silicon bronzes.

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Factors that May Determine the Service Life of Tin-Base Bearing Metals. D. J. Macnaughtan. Metal Ind. (London), Oct. 15th, 1937, page 380.

A review of modern developments, with several references.

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Important Points to Observe When Light Metals are Melted. M. Schied. Giessereipraxis, Vol. 58, page 250 (1937); Chem. Abstracts, Nov. 10, 1937, col. 7819.

Rapid qualitative methods are described for detecting common impurities in light metal alloys. These tests include detection of copper, zinc, magnesium and silicon in aluminum alloys, and identification of magnesium alloys. The selection of type of furnace and crucible, proper casting temperature and the need for a dry charge are discussed.

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Free-Machining Aluminum Alloys. H. Kastner. Metallwirtschaft, Vol. 15, page 1217 (1936); Chem. Abstracts, Nov. 10, 1937, col. 7820.

A high-tensile Al-Cu-Mg alloy containing lead, known as WI 301, is described with illustrations of the finished parts, of the machining operation and of the chips produced. Finer chips are made than with similar alloys without lead. WA 301 is copper-free and has good corrosion resistance. Free-machining properties are attributed to limited miscibility in the liquid, rather than to a definite element of structure. Alloying lead with aluminum requires careful technic because of the difference in density.

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The Influence of a Third Component on the Properties of Magnesium-Aluminum Alloys. Yu. A. Amsterdamskii. Legkie Metal., Vol. 5, No. 11, page 45 (1936); Chem. Abstracts, Nov. 10, 1937, col. 7821.

The addition of manganese, nickel, silicon, bismuth or antimony up to 0.3%, or of cadmium up to 2.15%, does not affect the age-hardening or mechanical properies of magnesium-aluminum alloys containing 7 to 10% aluminum. Cadmium dissolves in the magnesium-aluminum solid solution. The other elements form a new phase.

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The Influence of Titanium on Aluminum-Magnesium Alloys. G. Komovski et al. Legkie Metal., Vol. 5, No. 12, page 40 (1936); Chem. Abstracts, Nov. 10, 1937, col. 7821.

The addition of 0.4% titanium increases the tensile strength of aluminum alloys containing 8% magnesium.

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The Deoxidation of Brass and Bronze. J. Czochralski and Z. Bukowski. Chem Zentr., 1936, II, 170; Chem. Abstracts, Nov. 10, 1937, col. 7822.

Preliminary experimennts on the deoxidation of Al_2O_3, MgO, ZnO and CuO indicated that the use of PCl_5 gave the best results. The deoxidation actions of PCl_5 and of copper phosphide on brass (10% Zn, 90% Cu) and bronze (8% Sn, 92% Cu) were then studied more closely. Tensile strength, hardness, etc. were determined on specimens both with and without the deoxidation treatment. Results indicated that the PCl_5 was superior to the copper phosphide. The former produced a homogenous, fine-grained structure and raised the tensile strength and hardness.

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Light Alloys in Modern Automobiles. W. C. Devereaux. Metal Ind. (London), Nov. 19, 1937, page 499.

The author stresses the fact that the earlier disadvantages of light alloys for use as engine parts have now disappeared, due to improved practice, and that engine designers must revise their ideas in consequence. As specific applications for castings, pistons, cylinder heads and bearings are cited. In the development of aluminum-alloy bearings, accepted theories on bearing structures have been considerably modified; the only successful alloy types were those which contained a variety of hard constituents of widely varying hardness. These form a pattern which does not tear during machining nor pierce the oil film under conditions of poor lubrication.

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Atmospheres and Fluxes in the Melting of Wrought Phosphor Bronze. L. Kroll, F. E. Ball, E. A. Anderson. Metals & Alloys, Nov. 1937, page 307.

Experimental work on an alloy containing 7.5 to 8.0% tin, various percentages of phosphorus up to 0.25%. The authors find that in phosphorus bronze, neither an oxidizing nor a reducing atmosphere is fatal in melting; the use of sufficient phosphorus and the avoidance of overheating are more important. Melting in air, or in hydrogen, were not particularly harmful as compared with a charcoal cover. An atmosphere of inert gas, such as nitrogen, did seem to have some advantage. Barium oxide made an excellent cover.

• • •

High-Duty Brasses and Bronzes Available to the Engineer, Part II. E. Hudson. Metallurgia, Nov. 1937, p. 13.

In this article the author deals with the true tin-bronzes. By substituting nickel for 5% of the tin in the alloy 88:10:2 a heat treatable alloy is obtained, yielding a maximum strength of 37 tons, with an elongation of 16% and a Brinell of 171. High percentages of nickel result in even higher physical properties but foundry practice becomes more difficult. The author also discusses the use of small proportions of nickel in leaded bronzes, then describes the high-nickel bronzes and the leaded high-duty bronzes.

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Die Casting. Arthur Street. Metallurgia, Nov. 1937, page 29.

A review.

• • •

Gating Nonferrous Castings. N. K. B. Patch. Foundry, Nov. 1937, page 31.

An illustrated discussion of gating for red brass and bronze castings.

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Problems in Bronze. Harold J. Roast. Trans. Amer. Foundrymen's Assoc., Dec. 1937, page 399.

A rambling but very interesting account of the methods used to solve special casting problems.

Modern Production Equipment

New processes, machinery and supplies for metal products manufacturing and metal finishing

The Plate Type Copper Oxide Rectifiers

The last word in a source of low voltage, high amperage, direct current.

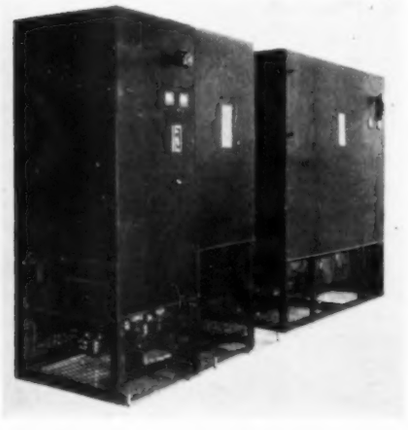
By CLARENCE E. BERGER

Electrical Engineer, Hanson-Van Winkle-Munning Co., Matawan, N. J.

For those manufacturers who require a source of low potential direct current for electrochemical processes, (6 volts or less), and who need fairly sizeable volumes, the choice lies between two types of equipment —the motor generator set and the plate type copper oxide rectifier.

During the last half century, the low voltage motor generator set as made in the United States has been brought to a very high state of perfection, and for some applications it is still the best type of equipment to use. However, it does present all the problems inherent in machinery with rotating parts: the proper installation, oiling, ventilation and bearing maintenance, in addition to the constant need for commutator and brush maintenance and replacement.

The commercial background of the copper oxide rectifier is only about ten years old. During this decade many thousands have been built for battery charging and other purposes, in the form of discs with low wattage output. For high wattage, the plate type has been developed and this form of rectifier has already had some years of experience behind it, both in the United States and in Europe.



In the foreground, a 1500 *ampere,* 6 *volt rectifier; in the background, a* 3000 *ampere,* 6 *volt rectifier*

General Characteristics of Rectifiers

Rectification, or the conversion of alternating current into direct current, can be accomplished by devices which fall into five distinct classifications. A common example of each of these classes is given below:

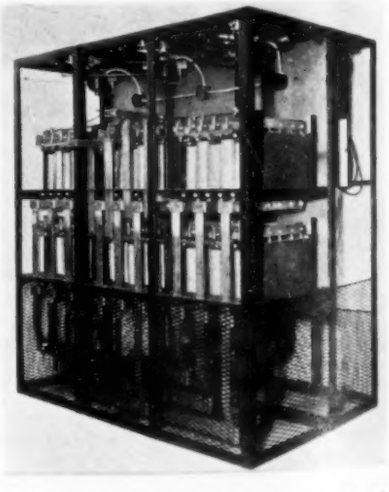
(a) the vibrating reed
(b) the mercury arc
(c) the hot cathode or Kenotron tube
(d) the lead-aluminum electrolytic rectifier.
(e) the galena crystal rectifier

The copper oxide rectifier belongs in the same class as the galena crystal; what is known as Composite Conduction Rectifiers and sometimes referred to as Junction or Contact Rectifiers. The last two names mentioned are more accurately descriptive of the actual construction of the copper oxide rectifier. Types a, b, c and d above have some useful applications but are not suitable for the production of large volumes of current at low voltages. It is for this type of work that the copper oxide rectifier is ideally suited.

Process of Rectification

The high voltage A. C. leads must be led in through suitable devices for connection and disconnection to protect the installation from overloads and short circuits. This is accomplished by a standard contactor, push button operated, with overload and low voltage protection. The current is then led to a suitable step-down transformer, which changes the current (still A. C.) to low voltage high amperage current. This transformer has the necessary taps on the primary or the high voltage side to give close voltage control over a wide range on the low voltage side. These taps are connected to a suitable dial switch, operated from the front of the rectifier. In the smaller sizes it is not necessary to shut off the power in changing taps, but in the larger sizes, power must be shut off before making the change.

The low voltage A. C. output from the main transformer is then connected to the rectifier plate assemblies which are really the heart of the rectifier. Here rectification takes place in a series of copper plates which have been oxidized by a special heat



Interior view of a 3000 *ampere,* 6 *volt rectifier*

Latest Products

Each month the new products or services announced by companies in the metal and finishing equipment, supply and allied lines will be given brief mention here. More extended notices may appear later on any or all of these. In the meantime, complete data can be obtained from the companies mentioned.

Variable "Speedial" Handwheel; can be substituted for the standard handwheel and hand crank on Reeves variable speed control equipment. Reeves Pulley Co., Columbus, Ind.

High Temperature Insulated Fan. Type MIH Thermo Exhausters for severe service conditions. Industrial Gas Engineering Co. Inc., 201 E. Ohio St., Chicago, Ill.

Portable Screw Driving and Nut Setting Machine. Stow Mfg. Co. Inc., Binghamton, N. Y.

Portable Oxy-Acetylene Cutting Machine. Type CM-15. Linde Air Products Co., 205 E. 42nd St., New York City.

treating process so that they have a uniform, dense and highly adherent coating of copper oxide. It is at the contact surface of the copper and the copper oxide that rectification takes place in a distance infinitely small, without the presence of any arcs or solutions, and with no moving parts involved. Contact for one polarity is made to the pure copper and for the other to the copper oxide coating by means of a sprayed metal coating and spring connectors. A number of such plates are then assembled into a rack with air spaces between them and the proper A. C. and D. C. connections and terminals are brought out.

To provide moving air through the spaces between the rectifier plates, a fan is installed which assures a proper flow of cooling air over all of the plates. An air vane relay is provided to stop the operation of the rectifier in case of fan failure.

Advantages of Rectifiers

All of the parts described above are assembled into a cabinet together with the necessary meters to make a complete, self-contained unit which has outstanding advantages. No special foundation or grounding-in is required. The unit need only be placed in a clean and well ventilated spot and connected to the A. C. power leads and the D. C. output leads. Push the "start" button, select the voltage at which it is necessary to work, by means of the tap changing switch, and the rectifier is in operation. There is practically no installation expense.

In performance, the rectifier has much to recommend it. In sizes up to 3000 amperes it has a higher efficiency than the motor-generator set and a power factor of approximately 95%. The voltage regulation is approximately 20% which compares favorably with the shunt wound generator. There is no expense for maintenance of brushes, bearings, commutators, etc.

Manufacturers who need a new or additional source of current for electrochemical work, should seriously consider the plate type copper oxide rectifier. It is no longer an experimental device but a sound, commercially practical and proven type of electrical equipment.

Alkali Stripping System

What is believed to be the largest installation of its kind is the alkali stripping system illustrated below and recently built by the Detroit Rex Products Company, 13005 Hillview Avenue, Detroit, Michigan. This system has been designed and built for the removing of paint from rejected metal parts in preparation for repainting, and removing of paint from racks and enamelling hooks.

The system consists essentially of two main tanks, with an auxiliary premix tank, hood arrangement, I-beam for monorail conveyor and traction wheel turns.

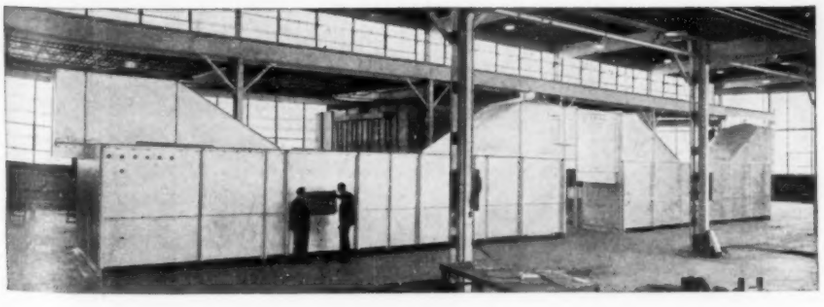
The tanks proper are fabricated from ¼ in. steel plate, and reinforced with structural steel angles and panels; the whole system being of all welded construction.

The capacity of the hot alkali strip tank is 15,400 gals., of the hot water rinsing and drying tank, 8,000 gals., and of the mixing and preheating tank, 1,500 gals. Steam heating coils are placed in all three of these tanks.

The hot alkali sprays are supplied by a centrifugal pump driven by a 3 HP. motor. Spray headers are mounted on the outside of the hood and have removable plugged openings for cleaning inside nozzles. Sprays are of the overhead type.

The operating cycle is briefly as follows: immersion for 20 minutes in hot alkali strip tank, followed by spray of hot alkali strip solution to keep surface of work wetted. The work then passes through cold water rinsing sprays, after which it is submerged into a final hot water rinse for two minutes. From the final hot water rinse the work leaves the exit end of the system with its surface stripped of paint, and dry to a degree sufficient to prevent immediate rusting.

The approximate overall dimensions of this alkali stripping system are: Length, 87 ft. 6 in.; Width, 13 ft. 2 in.; Height, 13 ft. 6 in. The approximate weight is 42,200 lbs.



Detroit Rex mammoth alkali stripping machine

Lacquer and Solvent Hose

In answer to industry's demand for a synthetic lined lacquer spray and solvent hose, United States Rubber Products, Inc., 1790 Broadway, New York, has announced its new U. S. Peerless Lacquer Spray and Solvent Hose—Off. P-243-Synthetic Lined.

Lacquer and synthetic enamel sprays usually contain butyl acetate and other solvents whose action is destructive to rubber,

U. S. Peerless lacquer spray and solvent hose

but this new hose has proven itself superior for this purpose, it is claimed. Thousands of feet are already in use in the automotive industry for automobile and truck body lacquer spraying. The service the hose has rendered is reported to be exceptional.

U. S. Peerless hose is also recommended for use as a solvent hose, particularly in conditions where elevated temperatures up to 150° play a part. Because the tube is of synthetic stock practically no swelling develops when it is used as a solvent hose. In the smaller sizes this feature is of great value as construction of flow due to swelling is reduced to a minimum.

The inner tube, made of a high grade synthetic rubber material, will resist the action of oils and commonly used paint solvents, in addition to lacquer solvents. It will not discolor delicate shades of paint. The body, of braided reinforcing plies of high grade cotton, has a smooth molded black cover of oil and abrasion resisting rubber stock.

Available in sizes ¼″ to¾″—1 and 2 braid.

Abrasive for Special Applications

General Abrasive Co., Niagara Falls, N. Y., has produced a new abrasive called EPT Lionite for special applications where little self dressing of the wheel occurs. This material which has greater friability, is designed to fill the demand for an abrasive that must be depended upon to fracture cleanly and constantly present new cutting surfaces. The purpose is to eliminate rapid wheel glazing and to permit using all of the abrasive before resetting the wheel. It is stated that the higher aluminum oxide content of EPT Lionite makes a sharper and faster cutting grain, and that longer wheel life is realized, which is reflected in operating costs. Due to a special oxidizing roast at high temperatures, the grain is said to have maximum capillarity and also to have etched surfaces which provide a better grip for the glue. The grains are crushed to polyhedral shape by a special crushing system.

Another quality of EPT Lionite is "packing" in the set-up trough. When this abrasive is rolled onto a wheel it packs and sticks; it does not slip aside and pile up.

Made for rough work, shock and stress, EPT Lionite is produced only in sizes of No. 90 and coarser.

New Parkerizing Process

Announcement has just been made by the Parker Rust-Proof Company of a new Parkerizing process, which, it is stated, combines all the effectiveness of the older process with some vitally important new qualities that result in increased efficiency and lower cost of application.

Parkerizing tumbling barrel tanks

Among the more important improvements is the matter of processing time. Instead of the 60 to 90 minutes required to apply the older process the processing time is now reduced to 30 minutes—about one-third of the time formerly required. This reduces the size and cost of the tanks and equipment required for a given output.

Another feature that contributes to economy in application is the reduction of operating temperature. The new processing solution reacts at 180°F. instead of 210°F. formerly found necessary, resulting in a lower heating cost.

The improved liquid chemicals develop less sludge in the processing tank and produce a finer grained, smoother coating. This assures less change in metal contour and a minimum of build-up in fine threads.

The protection from rust afforded by Parkerizing is applicable to many industries. The automotive industry is one of its largest users. The electrical industry, manufacturers of office equipment, builders of architectural iron and steel, stampings, castings, forgings or screw machine products, where an attractive, jet black finish is desirable and a high degree of rust resistance is essential, all find use for Parkerizing.

Spray Unit

The Eclipse Air Brush Co., 390 Park Ave., Newark, N. J., has just introduced a small pressure feed spray unit known as the B+, available in one- and two-quart sizes, for use with any Eclipse gun. This unit fills the gap between the cup gun and the full-size spray unit.

The B+ unit has all the refinements of control and adjustment found in larger Eclipse units: pressure regulator, air gauge, shut-off valve on air supply, Eclipse 3-way release valve and safety valve, mounted on a durable lightweight control head. The container screws directly into the control head. Four feet each of air and fluid hose connect the container and gun. A T-shaped handle for easy carrying also provides a means of hanging the container from belt, ladder or any convenient projection near the work.

With the B+ unit, the gun will spray with full efficiency in any position, including the vertical pointing directly up or down; which is not possible with the cup-attached type of equipment. By separating the gun from the container, it is possible to reach surfaces not accessible to a cup gun. The elimination of the weight of the container and material from the work-hand speeds up the operation and lessens fatigue.

Eclipse B+ Spray Unit

The low pressure principle, a feature of all Eclipse equipment, has been maintained in the B+ unit. Paints and enamels can be applied successfully at pressures as low as 10 lbs.; synthetics can be applied without "orange peel."

pH Papers for High Speed and Bright Nickel Solutions

The advent of high speed, hot nickel plating solutions and also bright nickel plating solutions has changed the practice in nickel plating to a considerable extent. These solutions operate at much lower pH values than the older baths.

For that reason Paul Frank, 456-4th Ave., New York, announces the availability of pH papers for measuring acidity, with a range from 1.6 to 3.7, suitable for these solutions. They have the same high accuracy as the papers have been known to show in the 5 to 6 range, and are recommended for control work in plant operation as they provide quick and easy method of measuring the acidity of the solution.

Carbonate Remover

The duPont Carbonate Remover made by the Electroplating Department of E. I. duPont de Nemours & Co., Wilmington, Dela., is a material developed to eliminate the need for "freezing out" or for using barium cyanide or chloride to remove carbonates from cyanide solutions. All these methods have their own disadvantages in point of expense or convenience. It is designed to remove carbonates by precipitation in the form of an insoluble carbonate; the precipitate to be inert or beneficial.

DuPont Carbon Remover is a calcium sulphate with a high degree of purity and is relatively inexpensive. It has relatively light solubility in the solution, which diminishes the introduction of deleterious impurities. It can be maintained in stock at all times, permitting continuous removal of carbonates as they are formed. It enables solutions to be operated continuously throughout the hot summer months.

New High Grade Zinc

The United States Smelting Refining and Mining Company, 57 William St., New York, for many years one of the leading producers of silver and lead, has announced its entry into the field of high grade zinc. Heretofore the zinc concentrates, mined at the company's Bingham properties near Salt Lake City, were sold to the Anaconda Copper Mining Company. Under a new arrangement, these will be refined by Anaconda for account of United States Smelting Refining and Mining Company, which

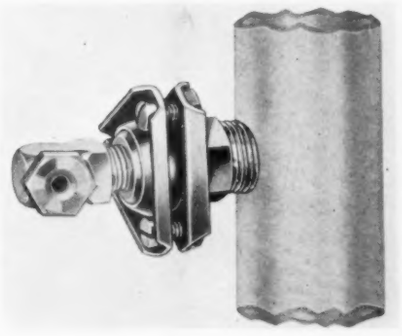
will sell the resultant zinc directly to the trade.

The company will offer the following grades of electrolytic zinc: special high grade, analyzing 99.99+% in zinc purity; intermediate; brass special; prime western. This zinc as well as the other metals produced by the company will be sold through its New York office at 57 William Street, New York.

Adjustable Joints

Spraying Systems Co., 4922 W. Grand Ave., Chicago, Ill., has developed a new line of adjustable joints for metal cleaning processing and various industrial washing.

These adjustable joints are of sturdy construction, accurately machined and are now available in the following size pipe connections: ¼" x ⅛", ⅜" x ¼", ⅜" x ⅜" and ½" x ⅜". All sizes are carried in stock made of brass, but can be had in any other material required.



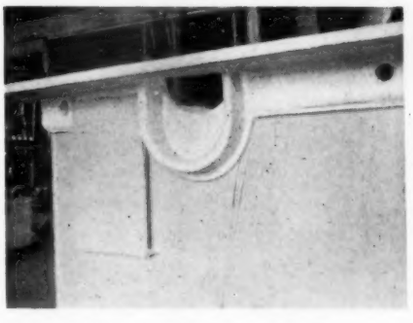
Spraying Systems adjustable joint

Tank Lining

Gollord, Inc., Detroit, announce a new and improved S. R. L. (Seamless-rubber-lining) for tanks and other containers, for use by the plating and chemical industries. This improved rubber lining is said to represent an entirely new technique in latex rubber formulation.

"Multi-Ply" S. R. L. is "tailored" to the walls of tanks, etc., in a single, seamless, smooth, unbroken finish, bonded to the metal or wood. Improved bonding methods permit the use of "Multi-Ply" S. R. L. under high temperature (212 F.) conditions, where contents permit.

Samples of "Multi-Ply" S. R. L., bonded to metal, together with an interesting booklet, "S. R. L. Tanks" will be mailed on request.



Collord S. R. L. for tanks

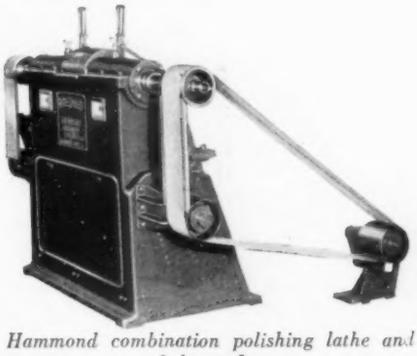
Combination Polishing Lathe and Belt Sander

The Hammond Machinery Builders, Kalamazoo, Michigan, announce a new Rite-Speed double spindle combination polishing lathe and belt sander.

Machine as shown has two separate and distinct spindles, each independent of the other and each operated by its own motor, starter, multi "V" belts, switch and brake. Belt sanders can also be mounted on the double end single spindle Rite-Speed polishing and buffing lathe as manufactured by this company.

With this machine, either end can be used for polishing or buffing or for sanding. In order to convert this lathe from a sander to a polisher, it is only necessary to remove the drive pulley mounted on the spindle and replace it with a buffing or polishing wheel.

This machine will be of particular interest to concerns that do not have enough sanding to warrant purchasing single purpose equipment as with this new Hammond combination machine they can polish, buff or sand and it only takes a few minutes to change operations.



Hammond combination polishing lathe and belt sander

Maintaining Cadmium Baths

A new product called Cadalyte Maintenance Compound has been developed by E. I. duPont de Nemours & Co., Electroplating Dept., Wilmington, Dela. Recommended for use in place of sodium cyanide, this material is a mixture of sodium cyanide and the organic or inorganic brightening agents. It is said to be so compounded that when used exclusively in place of sodium cyanide, the correct amount of each brightening agent as well as sodium cyanide is regularly and automatically introduced into the bath. Its purpose is to keep the bath operating at maximum brightness and efficiency without the need for analyzing for any ingredients except cadmium and sodium cyanide.

Electrolytic Tin Plating

The U. S. Patent Office on July 13th issued to Blaw-Knox Company, Pittsburgh, Pa., a patent on a method of producing tin plate. According to an officer of the company this method makes it possible to produce a sound adherent tin coating with the use of less tin than is required by previously used methods.

The scope of the patent is indicated by the following allowed patent claims. "In a process for producing tin plated steel strip, heating the strip to a temperature sufficiently high to anneal and temper the same, gradually cooling said strip while preventing contact with external air, joining portions of strip end to end to form continuous strip with good electrical contact at the joint, and moving the continuous strip uninterruptedly and at a substantially constant speed through the sequential operations of acid pickling, washing, electroplating in a tin bath in which the moving strip constitutes the cathode and passes between anodes distributed along the submerged portions of the strip, washing, and drying. said operations thus producing steel strip coated with an adherent and evenly distributed electro deposit of tin."

The patent is issued to the company on application of John S. Nachtman, who is now associated with the Electrochemical Processes Division of the Blaw-Knox Company.

High Strength Solder

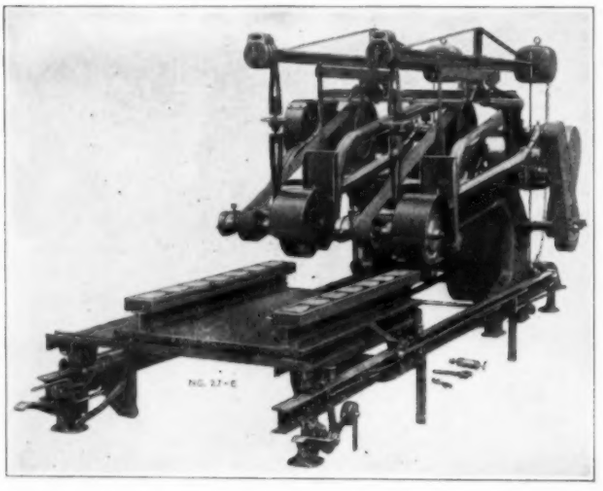
Richloy Hi-Tensile Solder is the trade name of a product of the National Cable & Metal Co., 1727 Standard Ave., Glendale, Calif. Important points in the claims made for this solder are greater strength, lower melting points, superior bonding qualities, easier flowing and sweating, cleaner finishes and better electrical conductivity. It is stated that Richloy has better distribution of the constituents, achieved by better alloying, and the use of only pure lead and tin; no additional or adulterating ingredients. According to tests made by Raymond G. Osborne Laboratories, Los Angeles, Calif., the 50-50 solder has an ultimate strength of 9577 pounds per sq. in., elongation of 32% and a melting point of 360 deg. F. The 60-40 solder has a tensile strength of 9412 pounds per sq. in., elongation 33.7% and melting point 364 deg. F.

Automatic Sole Plate Grinding and Polishing Machine

A new automatic, high-speed, ball-bearing, twin-spindle electric sole plate grinding and polishing machine is announced by Excelsior Tool and Machine Co., E. St. Louis, Ill. The structure of the machine is apparent from the illustration. It includes no delicate attachments or complicated adjustments and can be operated by anyone with some grinding experience. Dust hoods and spouts are standard equipment, one set of holding fixtures, wrenches, Alemite gun, one can of grease and two abrasive wheels.

The carriage travel is 30 lineal feet per minute, spindle speed 2500 R.P.M. for 14" diameter high speed grinding wheels. Spindle bearings are dust proof with oversized ball bearings; capacity about 200 pieces per hour, ground and finished, with variations depending upon the condition of the base metal and the finish desired.

The machine usually takes a 15 H.P. motor, 1750 R.P.M. motion. High speed hard center grinding wheels are used for the full width. The oscillating side motion of the carriage prevents straight line scratches and unequal wear on the face of the wheels. Holding fixtures can be easily removed to suit any size castings.



Excelsior automatic high-speed sole-plate grinder and polisher

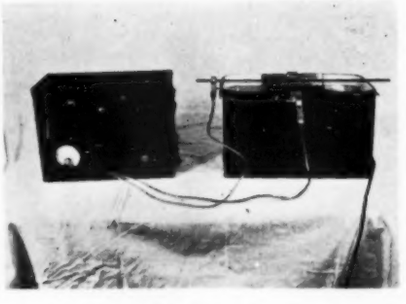
Direct Current Producer

The "Lectroplater" is a new, low priced electrical device for producing direct current for small plating installations.

The unit is neat, compact and complete, containing voltmeter or ammeter and equipped with a voltage regulator for controlling the voltage in ½ volt steps. No auxiliary rheostats or meters are required. It contains no moving parts and nothing to wear out. The device operates from 115 volt A.C. light circuit.

The Lectroplater is recommended for plating all metals with all types of baths. It is made in various standard sizes ranging from 10 to 100 amperes capacity at 6 volts.

The manufacturers, Lectroplating Products Co., 233 Curtis Bldg., Detroit, state that it is ideal for small factories, repair shops, jewelers, experimental laboratories and home work shops. Further information can be obtained on request.



The Lectroplater

Ten Year Old Lacquer Still Popular

As everyone familiar with industrial finishes knows, there are few industries which have developed as rapidly as lacquer and synthetics. Remarkable improvement in production finishing materials are brought out each year, and what was acclaimed a great advance a couple of years ago may be called obsolete today.

In its engineering of finishes for specific performance, the Roxalin Flexible Lacquer Company of Elizabeth, N. J. has explored every possibility in new raw materials and has developed a number of custom made products for definite performance. Yet in spite of this progress through continuous research on synthetic resins and new raw materials, Roxalin's original product, their Flexible Lacquer, now over ten years old, is still outstanding as a speedy air-dry finish. Roxalin points out that many large manufacturers, while keeping posted on new developments, continue to use these enamels because:

1. They do not require a primer on brass, aluminum, nickel, die casting or steel.
2. They require no baking.
3. They are oil and gasoline resistant.
4. Instead of gradually becoming more and more brittle they actually improve with age.
5. They will not crack or chip under severe abuse (metal finished with this material ten years ago has even been punched and formed into bottle caps without injury to the film).

Plating Rack Insulation

Nelson J. Quinn Co., 419-13 St., Toledo, Ohio, has developed two new materials for use in insulating electroplating racks. Zetyl 238 is a synthetic insulating compound recommended for plating racks to be used in chrome, copper, nickel, bright nickel, zinc, silver and in alkali cleaners. It is made to withstand temperatures up to 220 deg. F., is not affected by water or water solutions of acids and alkalies. This insulation should be applied over a wrapping of cotton tape or over a coating of Zetyl primer.

Clear Lacquer

The Agate Lacquer Manufacturing Company, Inc., Long Island City, New York, after considerable research has developed a clear, baking lacquer which air-dries in a comparatively short time, and after being baked at moderate temperatures for a moderate time, will stand blanking, forming, shearing and drawing. This lacquer will adhere to chromium and cadmium as well as brass, bronze, silver, gold, etc., without discoloring or dimming the metallic effect, and when baked will stand considerable wear and abuse including buffing.

Oil and Water Extractor

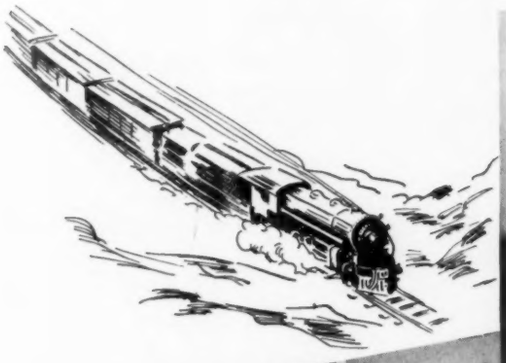
Designed to keep compressed air lines free from oil and moisture, the latest model Spraco oil and water extractor is maintenance-free, since it has no moving parts or packing and requires no adjustments. An automatic drain valve prevents the accumulation of condensate in the reservoir at the bottom of the extractor shell.

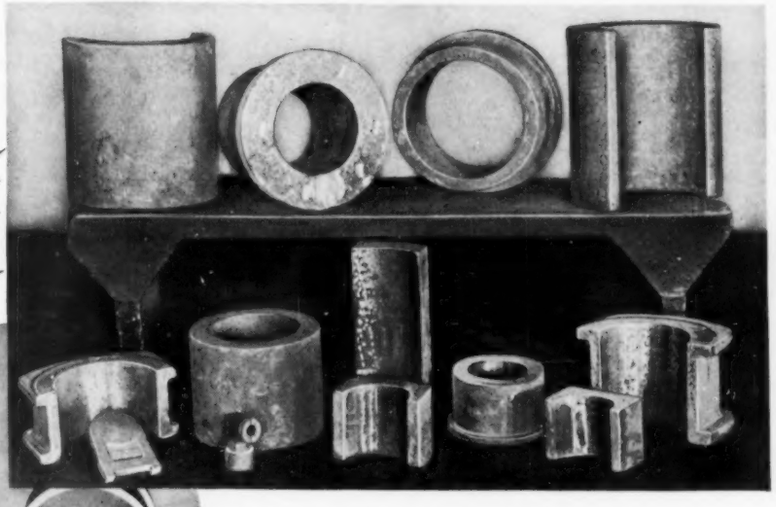
Elimination of moisture and free oil is obtained by the cooling effect of a small volume of circulating water passing through a cooling coil, by a reduction in the air velocity through the extractor, and by changes in the direction of air flow. Oil and water are collected on a series of baffles in the air stream, deposited in the reservoir and automatically drained off.

Sizes are available for 40 and 100 cfm. Larger capacities are provided by multiple units. For complete bulletin write to the Spray Engineering Company, 160 Central Street, Somerville, Mass.

Spraco extractor

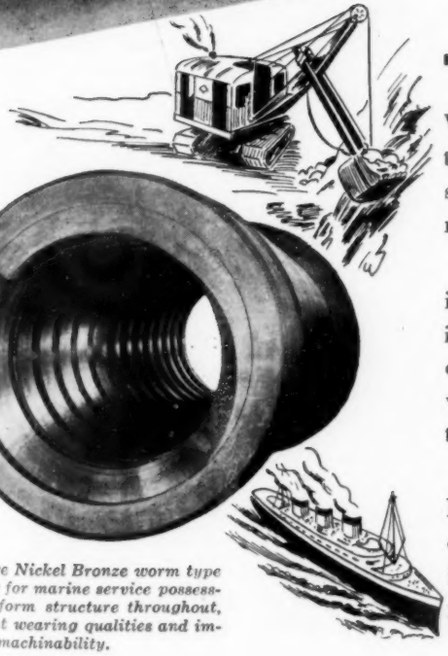
GREATER ENDURANCE FOR YOUR BUSHING BRONZES





ABOVE — *Group of Nickel Bronze locomotive castings produced by Canadian Bronze Co., Ltd., of Montreal.*

LEFT—*Finished bushings used on Lima Power Shovel (Product of Lima Locomotive Works, Ohio) cast from 1% Nickel Bronze*



• *Large Nickel Bronze worm type bushing for marine service possessing uniform structure throughout, excellent wearing qualities and improved machinability.*

...In Every Type of Service

WHEN small percentages of Nickel are added to bronze compositions, there is a marked betterment in elastic properties, tensile strength, compressive strength and hardness. Toughness, impact-resistance and density are also materially improved.

Worthwhile economies can also be effected in bronzes by substituting Nickel in equal amounts for the more expensive tin. Equal, and in many instances, improved physical properties result from these economical mixtures. The net result is greater endurance in service, with resulting low cost of maintenance to the user and lower production cost to the foundry.

Equally important to the foundry man is the fact that the use of Nickel does not present any difficulties in foundry practice. On the contrary, the increased fluidity effected by Nickel additions actually improves the general pouring characteristics. The result is fewer misruns, a widened casting range and lower pouring temperatures.

Our casting specialists will be glad to consult with you concerning the use of Nickel in your various castings.

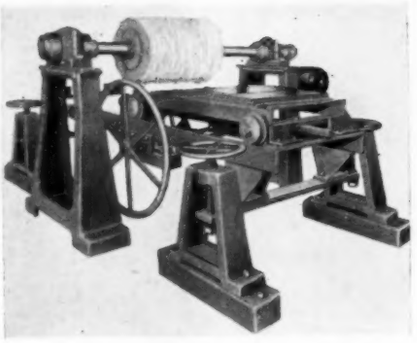
THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

Table Buffing Machine

Munning & Munning Incorporated, 202-208 Emmett Street, Newark, New Jersey, have recently perfected and added to their line, a flat stock buffing machine as illustrated, for surface finishing both metallic and non-metallic sheets, plates and slabs.

Flexible, light gauge stock of either plain or plated metals, half tone, photo-engraving, and equipment name plates, monument plaques, sound resisting boards, plastic, rubber, granite or other slabs, all of which are difficult to handle and polish uniformly by other means, are said to be conveniently and readily worked on this machine. Various types of finishes such as matte, satin finish or high luster are produced by the proper choice of wheel and cutting or coloring composition used.

The principle of the machine is simple, in that the buffing table on which the work is fastened, either mechanically, pneumatically or by magnetic chuck, advances toward and recedes from the buffing wheel which reciprocates while it rotates. The table is adjustable so that it may be raised to compensate for buffing wheel wear, and it is fully insulated against heat distortion.



Munning & Munning flat stock buffer

The machine in the design shown, is hand wheel operated. Automatic directional table drives are also offered.

These machines may be had with rack or chain drives, single or multiple buffing wheel spindles and automatic buffing composition feeds.

Chemical Tank Lining

Plast-O-Line is the name given to a new chemically resistant tank lining recently developed by Heil & Co., 3088 W. 106th St., Cleveland, Ohio. This lining is designed for use where flexibility and resistance to temperature are required. The company will furnish complete lined tanks to specification or will line old tanks in place at the customer's plant. Brick sheathing is also supplied.

Plast-O-Line is a black thermo-plastic material for use on metal, wood or concrete. It is laid on in thicknesses from ⅛" to ½". Among the properties given for it are flexibility and resistance to temperatures up to 212°F; non-conductor of current; low thermal conductivity; not affected by sudden temperature changes.

It is recommended for acids (except chromium and hydrofluoric) alkalies, salts, plating solutions (except chromium) and metal pickling. Bulletin No. 48 which will be sent on request gives full details.

Bulletin No. 50 illustrates "Nocorodal" carbon heating devices for use in muriatic and hydrofluoric acid solutions. These include steam jets, coil loops and electric immersion units.

Chrome Refinishing Kit

A new method for removing rust from chrome-plated metals and protecting the chrome so it stays bright and shiny is announced by the du Pont Company, Wilmington, Del. The new development will be marketed in the form of a Chrome Refinishing Kit, which contains a tube of a specially formulated paste cleaner, a can of protective lacquer and a brush for applying the lacquer.

The lacquer is a clear, methacrylate product which dries in 15 minutes, forming an invisible film over the surface. The lacquer may be used for protecting bronze, brass, nickel and copper, which are subject to rust and tarnish. Particularly designed for chrome auto parts, the lacquer is also recommended for building hardware, bronze name plates, trophies, bank fixtures and metal objects which are exposed to weathering. Methacrylate, the base of the new lacquer, is used in the du Pont plastic "Lucite", and is also being introduced in other fields.

The cleaner is primarily for automotive chrome, and is used preparatory to applying the lacquer. Other metals may be polished with milder metal or silver polishes before the lacquer is applied. Since most polishes leave an oily film which may prevent the lacquer adhering properly, it is recommended that the metal be rubbed with naphtha or tri-clene after polishing.

The Chrome Refinishing Kit is primarily a consumer product, but larger sizes of the cleaner and lacquer are available separately for industrial use.

Manufacturers' Literature

"Copper and Copper Alloys," by M. G. Steele. A brief summary, for engineers and purchasing agents, of the important properties and typical industrial applications of thirty representative coppers and copper base alloys. Revere Copper and Brass Inc., 230 Park Ave., New York.

Washer Stock List. No. 55-B; Thousands of washer specifications in various materials including steel, brass, copper, aluminum, etc. Wrought Washer Mfg. Co., 2100 S. Bay St., Milwaukee, Wisc.

Products and Services—FCC. Forgings, composite die sections, etc. The Forging and Casting Corp., Ferndale (Detroit) Mich.

Multi-Range Arc Welder. Hobart Simplified welder stating a variety of advantages: deposits more weld metal per hour; welds more lineal feet per hour, etc. The Hobart Bros. Co., Box EW-64, Troy, Ohio.

Buffing Wheel Rakes. "Advance." Made of heavy gauge steel, hardened, with man's size wood handle. The rake is easily removed for replacement with new rake filler. Matchless Metal Polish Co., 726 Bloomfield Ave., Glen Ridge, N. J.

Standard Trade and Securities. Page ML-103. July 13, 1938. Metals (Non-Ferrous) Basic Survey, including: Domestic Copper Industry; Lead Industry; Zinc Industry; Earnings and Dividends; Individual Company Analyses. Standard Statistics Co., Inc., 345 Hudson St., New York.

Standard Trade and Securities. Page ML-91. Supplements the Basic Analysis of Metals (non-ferrous) industry dated July 13, 1938, and carries current opinions on leading stocks. Standard Statistics Co. Inc., 345 Hudson St., N. Y.

"Joined for Life Against Stress and Corrosion." Construction with welded Monel, Nickel and Inconel. International Nickel Co., Inc., 67 Wall St., New York.

Contour Measuring Projector. Catalog D-27. A new contour measuring projector embodying new features. Bausch & Lomb Optical Co., Rochester, N. Y.

Potentiometer-Pyrometers. Bristol's Pyromaster. For automatic control furnace, oven and kiln temperatures; highly-accurate, vibration-proof, withstanding severe plant use. Bristol Co., Waterbury, Conn.

Variable Speed Control. Catalog No. G-384; handsomely bound. Three Reeves speed control units: Variable Speed Transmission; Vari-Speed motor pulley; Motodrive. Reeves Pulley Co., Columbus, Ind.

Dust Control. Bulletin No. 90, a recent revision of the previous cloth type dust filter equipment bulletin. W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland, Ohio.

Improved Centri-Merge Wet Dust Collector. Bulletin No. 91. Manufactured under Schmieg patents. W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland, Ohio.

"The Third Essential." A practical method for judging the service of steam specialty equipment. International Nickel Co., Inc., 67 Wall St., New York.

Cold Setting Acid Resistant Cement. Bulletin N-1. Properties; directions for use; preparation of alcoholic sulphuric acid solution; preliminary coating; chemical resistance table. Haveg Corp., Newark, Dela.

Portable Electric Grinders. Tool post, angle plate, internal, aerial and hand types. Bulletin No. 383. Wodock Electric Tool Corp., 4627 W. Huron St., Chicago.

Watch for the Coming Issues of Metal Industry!

Summer is supposed to be a dull time but Editorially it is never dull with us. Note the articles which we have ready for publication—waiting for a chance to get in!

The Cost of Nickel Plating by Joseph Haas.

Getting the Most Out of Your Lacquer by W. T. Smith.

Galvanic Reproduction from Metal Molds by George Schor.

Manufacturing High Grade Brass and Bronve Valves and Fittings by Francis A. Westbrook.

Every one of these articles is full of interesting and valuable information. Don't miss them!

Watch for the Coming Issues of Metal Industry!

New Books

Arc Welding and How to Use It. Published by Hobart Brothers, Hobart Sq., Troy, Ohio. 340 pages. Price $1.50 in the United States; $2.00 in Canada and foreign countries.

Divided into six sections, the following subjects are discussed: General Information on the development of arc welding; weldability of metals; applications or uses; various types of joints and welds; welding rods; welding speeds and costs; a series of practical welding lessons; information on carbon arc welding and cutting plus instructions for welding of non-ferrous metals; special information, particularly interesting to engineers, designers, supervisors, etc., with a discussion of standard steel shapes, welding symbols, sheet steel and wire gauges; physical properties of elements and metals; weights of alloys and other special data; modern welding equipment briefly described.

Nema Motor and Generator Standards. Publication No. 34-22, superseding previous edition of the same publication No. 34-22 which was published in 1934. Published by the National Electrical Manufacturers Association, 155 E. 44th St., New York. Price $2.00.

This book contains all the information in the previous edition somewhat modified and augmented. Some of the new material published in this book includes: temperature ratings of various types of enclosed motors; standardized lettering for flange mounted motors; methods of measuring motor vibration, etc.

Directory of New England Manufacturers. 1939 Edition. Published by George D. Hall, Inc., Boston, Mass. Price $15.00 before September 1st; thereafter $20.00.

In this revised edition there are over 2000 new concerns and over 10,000 changes in personnel. It contains the names of the firms' president, treasurer, sales and advertising managers, purchasing agent, number of employees, and products manufactured. Also included is information regarding the location of the plants and branch offices, and the capital structure of the firm.

The second section of the Directory is devoted to the classification of the same concerns by state and city or town.

Of particular value to purchasing agents is the third section of the Directory. Here all products are listed alphabetically, together with the names and addresses of the New England manufacturers. There is also, a "Brand Name Section" in which brand or trade names of all New England products are listed, with the names of the manufacturers.

Symposium on Correlation Between Accelerated Laboratory Tests and Service Tests on Protective and Decorative Coatings. Presented at the Fortieth Annual Meeting of the American Society for Testing Materials, June 29, 1937, New York City. Published by the American Society for Testing Materials, Philadelphia, Pa. Size 9 x 6, 48 pages. Price 60c.

The symposium is divided into three sections covering tests on the following topics: (1) finishes for interior surface (2) paints for exterior surface on wood (3) paints for iron and steel.

Of special interest to metal products manufacturers are the papers in Topic 1, as follows:

Relation between Accelerated Tests and Service Behavior of Finishes on Telephone Apparatus—C. C. Hipkins, Member of the Technical Staff, Bell Telephone Laboratories, Inc.

Significance of Tests on Organic Finishes Specified by Consumers—Leo Roon, Technical Director, Roxalin Flexible Lacquer Co., Inc.

Accelerated Tests on White Interior Metal Finishes—J. B. Bullitt, Jr., Chemist, Finishes Division, Philadelphia Laboratory, E. I. du Pont de Nemours and Co., Inc.

Accelerated Testing of Furniture Lacquers—W. H. Lutz, Technical Director, Pratt & Lambert, Inc.

Resistance to Cold Checking of Lacquers and Other Surface Coatings—Wayne C. Norris, Resin Development Laboratory, American Cyanamid and Chemical Corp.

Fundamental Factors in Film Integrity—Robert J. Moore, Development Manager, Varnish Resin Division, Bakelite Corp.

Laboratory Testing of Inside Flat Wall Finishes from the Consumer's Viewpoint—E. F. Hickson, Chief, Paint Section, National Bureau of Standards.

Welding Handbook. Published by American Welding Society, 33 W. 39th St., N. Y. City. Size 6 x 9; 1210 pages. Price $6.00; foreign $6.50.

The first edition of the Welding Handbook is offered to supply a demand for a complete volume of practical, up to date information. It covers the fundamentals, the materials used, testing methods and applications. It is the result of the work of 90 authors and 250 interviewers.

Under Processes, the book includes descriptions of arc, resistance, spot and thermit welding; soldering and brazing; flame hardening and metal spraying. Under Materials and Metallurgy, considerable space is devoted to copper, aluminum and nickel. A chapter is devoted to critical digests of welding literature.

The book is indexed and includes a number of useful tables. It is a most valuable work.

Electroplating: A Survey of Modern Practice, by Samuel Field and A. Dudley Weill. Published by Pitman Publishing Corp., 2 W. 45th St., New York. Size 5 x 7½; 381 pages. Price $4.00.

The third edition of this well known work which has been extended mainly along two lines: inclusion of material on the considerable work which has been done during the past few years on the fundamental theoretical principles of electroplating, and also on the methods of control and solution and process by analysis, etc.

Notched Bar Impact Testing. Published by Butterly & Wood Ltd., 10 Amber St., Shudehill, Manchester, 4, England. Size 5½ x 8¼; 229 pages. Price 3s 6d.

A discussion on notched bar impact testing reprinted from the Transactions of the Manchester Association of Engineers. It includes the following papers and the discussions which ensued: Impact Testing from a Physical Standpoint by Prof. R. V. Southwell; Some Aspects of the Notched Bar Test by L. W. Schuster; The Development and Present Position of Continental Research on the Notched Bar Impact Test, by Dr. Ing. Max Moser; Discussion of the Impact Test, by Capt. R. K. Haskell and H. C. Mann.

The Science of Dental Materials, by Eugene W. Skinner, Associate Professor of Physics, Northwestern University Dental School. 411 pages. Published by W. B. Saunders Company. Price $4.50.

Though this book was written primarily as a textbook for undergraduate students of dentistry, it contains much of value for several other groups, including jewelers and metal workers in general.

It is well known that the dental fraternity has developed much skill in the art of casting metals, including those of high melting points; extreme accuracy of reproduction is demanded in even the simpler dental restorations, and the techniques and materials employed are here described in details that artisans in other fields might profitably study.

As the title indicates, the book provides data on the working properties of such materials as plaster-of-Paris, impression compounds, vulcanite, the new plastics and synthetic resins, stainless steels, gold alloys, porcelains, cements, polishing agents, amalgams, fluxes, waxes, and the like. The brief exposition of the fundamentals of metallurgy may be read to advantage by metal workers in any field.

The reviewer believes that more space might have been given to the new precious-metal alloys containing platinum group metals. However, where there is so much value, this omission may perhaps be forgiven.

A prominent dental technician who examined the book remarked that many an older dentist and dental technician would

find value in the figures given, especially those on the newer plastics and alloys.

The appendix contains the American Dental Association Specifications for dental amalgam alloys, inlay casting investment, impression compound, inlay casting wax, casting golds, dental mercury, wrought gold alloys, wrought gold wire alloys, and dental cementing medium.

—Jewelry Metallurgist.

Tentative Recommended Good Practice Code and Handbook on the Fundamentals of Design, Construction, Operation and Maintenance of Exhaust Systems. Published by the American Foundrymen's Association, 222 W. Adams St., Chicago, Ill. Price $4.00 per copy; 50% discount to members of the A.F.A.

Complete engineering information essential to the proper design and construction of exhaust systems. Among the divisions of this subject are: Theory of Air Flow in Exhaust Systems; Application of Exhaust Systems; Application of Collection Equipment; Air Flow Producing Equipment; Designing and Calculating and Exhaust System; General Construction Specifications; Operation, Supervision, and Maintenance of Exhaust Systems.

Aluminum, by Douglas B. Hobbs. Published by Bruce Publishing Co., 524 N. Milwaukee St., Milwaukee, Wisc. Size 6 x 9. Price $3.00.

The history, metallurgy and uses of aluminum with projects for the school and home shop. The author combines the theory of aluminum metallurgy with metal working and the actual use of the metal. Part 1 is devoted to the history, metallurgy and use of aluminum; Part 2, to products made of aluminum, for the school and home shop.

Engineering Materials and Processes, by William Howard Clapp and Donald S. Clark, California Institute of Technology. Published by International Textbook Co., Scranton, Pa. Size 5¼ x 8¼, 543 pages. Price $4.50.

Brief treatment of the physical properties and uses of the principal engineering materials, together with a description of the methods by which these materials are processed. Information for the engineer on the properties and limitations of materials (metals and plastics) and how they are made available for use.

Technical Bulletins; paper bound. Published by Technical Service Bureau, Inc., 6805 N. Clark St., Chicago, Ill. Price $1.00 each, subject to discount for orders in quantity.

Subjects covered include the following:

Silver Soldering and Brazing
Electroplating with Copper, Nickel and Chromium
Electroplating with Gold and Silver
Electroplating with Zinc and Cadmium
Electroplating Non-Metallic Objects and Electroforming
Flexible Molds for Casting Small Objects
Electroplating with Alloys
Stainless Steel Easily Soldered, Brazed or Welded
Mirror Silvering
Soldering
Buffing and Polishing Metals
Coloring Metals Chemically

Creep Data. Published by American Society of Mechanical Engineers, 29 W. 39th St., New York. Size 8½ x 11, 900 pages. Pre-publication price $10.00.

Assembly of creep data on cast iron, alloy steels, including stainless steels, and some non-ferrous metals. The first assembled compilation of this type; also unpublished data including more than 300 creep tests.

Poor's Industry and Investment Surveys. Copper Mining and Fabricating Industry. Published by Poor's Publishing Co., 90 Broad St., Wellesley, Mass. Price $5.00.

Analyses of stocks of copper producing and manufacturing companies; also outlook for the industry and advice on investments in this field.

Poor's Industry and Investment Surveys. The Steel and Iron Industry. Published by Poor's Publishing Co., 90 Broad St., Wellesley, Mass. Price $5.00.

Analysis of the stocks of companies manufacturing iron and steel. Outlook for the industry and advice on investments in this field.

Testing and Grading Foundry Sands and Clays. Published by American Foundrymen's Association, 222 W. Adams St., Chicago, Ill. Price $4.00. One copy free to each member of the A.F.A.; additional copies to members at 50% discount.

The first revision since 1931. The new edition is enlarged and contains many new tests for sand and clays.

Statistical Year Book of the International Tin Research and Development Council, 149 Broadway, New York. 200 pages. Price $1.50.

A statistical description of the tin producing industry; also a complete history in figures of the International Control

scheme. Figures on consumption of tin including tinplate, solder, bearing metals, etc.

Elastic Properties of Non-Ferrous Metals and Alloys: Collected Data. By J. McKeown and E. D. Ward. Published by British Non-Ferrous Metals Research Association. Price 6s.

Most of the data are given in the form of tables, but occasionally, where space is saved thereby, graphical representation is used. In addition to data on elastic properties, the tables in a large number of cases contain information on the ultimate tensile strength and elongation of the materials. The metals and alloys included in this report have been divided into groups as follows: copper and its alloys (further divided under six sub-headings); nickel, cupro-nickels and nickel alloys (five subheadings); light metals (aluminum; aluminum alloys; magnesium and alloys); gold, silver and platinum group metals. Altogether 219 metals and alloys are tabulated. A list of literature references from which the data were obtained is provided, together with an index.

Technical Publications

Silicosis in the Foundry Industry, by Dr. Leonard Greenburg, Executive Director, Division of Industrial Hygiene, New York State Department of Labor, N. Y. Published by Safety & Hygiene Section, American Foundrymen's Association, 222 W. Adams St., Chicago, Ill.

A survey of over 4,000 foundry workers. The report indicates a lower rate of incidence of silicosis in foundries than has been generally supposed; hazard in the foundry industry is of borderline grade.

Nickel—A Versatile Automotive Metal. By H. E. Blank, Jr. International Nickel Co., Inc., 67 Wall St., New York.

Accident Rates in the Metal Products Industries in 1937. National Safety Council, Inc., 20 N. Wacker Drive, Chicago, Ill.

Accident Rates in the Non-Ferrous Metals Industry in 1937. National Safety Council, Inc., 20 N. Wacker Drive, Chicago, Ill.

Accident Rates in the Foundry Industry in 1937. National Safety Council, Inc., 20 N. Wacker Drive, Chicago, Ill.

The Precious Metal Mining Industry. Poor's Industry and Investment Surveys. The market outlook for the stocks of companies mining gold and silver. Poor's Publishing Co., 90 Broad St., Wellesley, Mass.

Galvanizing and Tinning. A Bibliography of Technical Articles, written by Wallace G. Imhoff. Over 300 publications dealing with pickling, hot dip galvanizing, hot dip tinning and various steel making practices.

Associations and Societies

Hogaboom Chairman of A.E.S. Research Committee

George B. Hogaboom of the Hanson-Van Winkle-Munning Co., Matawan, N. J., has been appointed Chairman of the Research Committee of the American Electro-Platers' Society. Details of the membership of this Committee will be made public shortly.

Detroit Branch

Secretary, T. C. Eichstaedt, 679 Virginia Park, Detroit, Mich.

The Annual Summer Outing of the Detroit Branch of the American Electro-Platers' Society was held on Saturday, August 6th, at Sandy Mac's Golf and Gun Club, Detroit. The program included golf, horseshoe pitching, baseball, sprints for fat men and others, three-legged race, wheelbarrow race and a special "mystery" prize. A buffet dinner was served and "taps" were kept open all day.

Programs arranged for coming meetings include the following:

September 10: *H. R. Norgren*, special representative Detroit Rex Products Co., Detroit, Mich. Subject: *Modern Developments in Vapor Degreasing*; illustrated with motion picture film.

October 8: *R. J. Amberg*, sales representative Johns-Manville, Detroit, Mich., Subject: *Celite Filter Aids*; illustrated by a talking motion picture describing the formation, mining and properties of the product.

November 4: *Dr. A. Kenneth Graham*, consulting engineer, Jenkintown, Pa. Subject: *Rochelle Salt Copper Plating Baths.*

December 2nd: *Dr. Colin G. Fink*, Professor Electrochemistry, Columbia University, New York City. Subject: to be announced later.

Electrochemical Society

Columbia University, New York City

The Fall meeting of the Electrochemical Society will be held at Rochester, N. Y., October 12 to 15, 1938, at the Hotel Seneca.

A special symposium will be devoted to the metallurgy of silver. Papers have been promised on the deposition of silver alloys and the porosity of silver plate.

Other papers scheduled for this meeting are:

"*Anodic Behavior in Cyanide Copper Plating Baths*," by H. J. Read and Dr. A. Kenneth Graham.

"*The Electrochemistry of Corrosion*," by R. H. Brown and R. B. Mears.

"*Effect of Pressure on the Passivity of Various Metals*," by H. V. Tartar and C. A. Littler.

"*Electrodeposition of Silver from Solutions of Silver Nitrate in the Presence of Addition Agents*," by R. Taft and L. H. Horsley.

"*Direct Method of Measuring Polarization on a Rotating Electrode and Its Application to the Study of Copper Deposition from Sulfate Solutions at High Current Densities*," by A. A. Boulach.

"*Ammonia in the Electrodeposition of Brass*." by L. C. Pan.

American Foundrymen's Association

222 W. Adams St., Chicago, Ill.

The St. Louis Chapter of the American Foundrymen's Association is sponsoring a regional two-day foundry conference on October 7 and 8, in Rolla, Mo. Among the papers featured at this conference will be:

Selection and Application of Non-Ferrous Alloys, by J. W. Kelin, Federated Metals Corp., St Louis, Mo.

Testing and Control of Molding Sands, by H. W. Dietert, Harry W. Dietert Co., Detroit, Mich.

Refractories from Missouri Clays, by C. M. Dodd, Professor, Missouri School of Mines, Rolla, Mo.

Personals

William M. Phillips

As reported in the July issue of METAL INDUSTRY, William M. Phillips, engineer of finishes, General Motors Corp., Detroit, Mich., was elected president of the American Electro-Platers' Society, at the annual meeting held in Milwaukee, June 13-17. For a number of years he has been one of the outstanding members of the Society. A pioneer in the battle for quality plating, he was one of the first to undertake the project of setting up specifications for electroplated coatings. The research work sponsored by the American Electro-Platers' Society, being carried on by the National Bureau of Standards, is in no small measure the result of his efforts.

Mr. Phillips was born September 9, 1889, in Aspen, Colo., the son of George and Susan B. Phillips. In his early youth he was brought to central Pennsylvania, the home of his ancestors, (one of whom, Col. Bucher, served as a staff officer under General Washington in the American Revolution.) Mr. Phillips graduated from Alexandria High School and Mercersburg Academy, and then from the University of Pennsylvania where he specialized in chemical engineering.

Mr. Phillips' experience in industry has been wide. He spent some time with the Philip Carey Co., Cincinnati, Ohio, becoming sales manager of their roofing division. In 1913 he went with the Baltimore Tube Co., Baltimore Md., as chief chemist and

WILLIAM M. PHILLIPS

later became manager of a division which specialized in the manufacture of copper products by electrodeposition. At a later date, when this division became an independent organization in Detroit under the name of the Inland Manufacturing Co., Mr. Phillips was made general manager. During the War his company furnished the shipyards with over a million parts made by electrodeposition. After the War he went with the General Motors Corp., where his duties now consist of production engineering in an advisory capacity on metal finishes of all kinds including plating, painting and enameling. He is also active in committees concerned with the specifications of metals.

Mr. Phillips lives in Birmingham, Mich., where he is a member of several social and civic organizations. He is also a member of the American Society for Testing Materials, the Electrochemical Society and a number of other technical organizations.

Edward Magnuson Celebrates 60th Birthday

More than 128 guests from all over the country joined in the celebration of the 60th birthday of Edward Magnuson, president of Magnuson Products Corp., Brooklyn, N. Y., at a lawn party on the Fourth of July, at his home in Amityville, N. Y. This day was also made the occasion of a Swedish-American Celebration as Mr. Magnuson is vice-president of the Board of Directors of the Swedish Hospital in Brooklyn.

Mr. Magnuson received numerous gifts including some from relatives in Sweden, among whom is his brother Karl Magnuson who has been 30 years a member of the Congress of Sweden and has been decorated by the King. Twenty of Mr. Magnuson's friends presented him with a large tablet on which was mounted a silver book inscribed with the names of the donors. Hon. P. B. Hanson, Judge of the Children's Court in Brooklyn, and president of the Swedish Hospital acted as Toastmaster. Over 100 telegrams were received from all over the world. Among the guests were representatives from the Swedish Tercentenary Celebration held last week in Wilmington, Del., where Mr. Magnuson was present as a Patron.

Judge Hanson (left) congratulating Edward Magnuson on his 60th birthday.

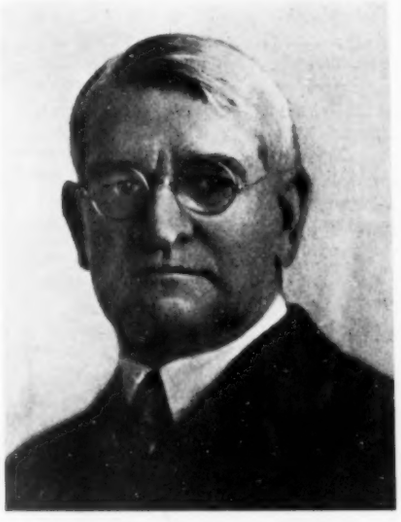
At a dinner tendered to the Swedish-American Tercentenary Association in honor of H.R.H. Crown Prince Gustaf Adolf and the sponsor patrons of this Association, held at the Ritz Carlton Hotel, June 30th, Mr. Magnuson was decorated by the King of Sweden through Prince Bertil. The decoration was bestowed for activities in Swedish charitable organizations and for participation as a sponsor patron in the Swedish Tercentenary in commemoration of the 300th anniversary of the first Swedish colony in America. Mr. Magnuson also received a letter of appreciation from Crown Prince Gustaf Adolf for his efforts in the entertainment of the Swedish Boy Scouts last summer at the Washington, D. C. Boy Scout Jamboree. The Crown Prince is the head of the Boy Scouts in Sweden.

Raymond Szymanowitz, formerly technical director of *Acheson Colloids Corp.*, has been moved up to vice president and technical director of Acheson Industries, Inc., technical development company for the Acheson interests. In his new capacity, Szymanowitz will continue supervision of all research activity of Acheson Colloids Corp., Port Huron, Mich.

Obituaries

Edward Otis Goss

Edward Otis Goss, 72, president of the Scovill Manufacturing Company, Waterbury, Conn., and one of the nation's best known industrialists, died in Waterbury, Conn., Monday, July 4th, at his residence, 117 Pine Street. He was the head of the oldest brass company in the United States. He was a native of Waterbury and for years has been an influential figure in various phases of community activities.



EDWARD OTIS GOSS

Mr. Goss was born in Waterbury on September 29, 1865, the son of Chauncey Porter Goss and Caroline Ketcham Goss. He was graduated in 1887 from Massachusetts Institute of Technology. He started with the Scovill company, first as a draftsman. He became assistant treasurer in 1900, general manager in 1911, vice-president in 1920.

During Mr. Goss' presidency the company expanded greatly, acquiring the American Pin Co., the Oakville Pin Co., the Gilchrist Co. of Newark, N. J., the Hamilton Beach Co. of Racine, Wisc., the Morency Van Buren Co. of Sturgis, Mich., and the Schrader Co. of Brooklyn, at a total valuation of more than $25,000,000. Under his direction the Scovill company weathered the depression and maintained yearly dividends throughout the period, at the same time keeping several thousand employees on the payroll.

Mr. Goss was a director and former president of the Citizens and Manufacturers National Bank, Waterbury, the New Haven Railroad, the Connecticut Co. and Landers, Frary and Clark. He was a Fellow of the Royal Society of Arts in London, a member of the New England Council, the American Society of Mechanical Engineers and the American Institute of Mining and Metallurgical Engineers.

In 1891 he married Miss Harriet Wheeler. Three sons, former Representative Edward W. Goss and William M. and Elliot P. Goss survive.

Verified Business Items

Kroder Reubel Co., Inc., 108 Meeker Ave., Brooklyn, N. Y., has filed plans for a new three-story plant, 50 x 100 ft. at 77-81 Herbert St. The cost will be over $75,000 with equipment. The company manufactures metal fixtures, hardware, etc.

General Motors of Canada Ltd., Regina, Sask., Can., will purchase and install machinery at its plant in Oshawa, Ont., Can., at a cost of $75,000. *J. B. Highfield* is plant manager.

National Safety Marker Co., Pontiac, Mich., recently organized to manufacture bronze safety lane markers for traffic service on city streets, has taken office space in the Peoples State Bldg., Pontiac. The company's foundry work is being done by the *Oakland Pattern & Mfg. Co.* of this city. *C. E. Summers* and *W. A. Engelhart* head the new company. Principal base metal used is bronze.

Reynolds Blower Co., Grand Rapids, Mich., is planning a one-story factory 60 x 120 ft. to cost about $50,000 with equipment.

Jamestown Metal Equipment Co. Inc., Jamestown, N. Y., manufacturer of automobile radiators and metal products, 1088-1132 Allen St., has awarded contracts for construction of the second unit of its expansion program. The latest addition will be a one-story brick, steel and concrete structure, 75 x 121 ft. in size.

"*Wheelabrating — the Modern Airless Method of Abrasive Blasting*," is the title of a new industrial movie (in color) recently completed by the American Foundry Equipment Co., 408 S. Byrkit St., Mishawaka, Ind. The film gives a complete pictorial explanation of the Wheelabrator method of abrasive blasting. Anyone interested in having a private showing of this movie at their plant or before a trade association meeting can make arrangements by writing the factory.

Dravo-Doyle Company, Pittsburgh, Pa., will represent The McKay Company, Pittsburgh, as distributor for the complete McKay line of Arc-welding Electrodes. The Dravo-Doyle territory will cover the "Tri-state" area, including Western Pennsylvania, Eastern Ohio and all of West Virginia.

Sealy Mattress Co., Woodwether Rd. & Santa Fe Sts., Kansas City, Mo., manufacturer of bed springs, etc., has awarded general contract for one-story addition, 67 x 125 ft., for expansion in spring division and improvements in present plant. Cost over $50,000 with equipment. Principal base metal used: steel.

Independent Register Co., 3747 E. 93rd St., Cleveland, Ohio, manufacturer of heating and ventilating registers, etc., has let general contract for one-story addition, 110 x 140 ft. Cost over $75,000 with equipment. Departments: stamping, welding, polishing, degreasing, cleaning, lacquering and enameling. Principal base metal used: steel.

C. S. Rogers & Co., have been organized with headquarters at 228 N. LaSalle St., Chicago, Ill., to manufacture and distribute process materials used in the metal working industries including carburizers, heat treating and drawing salts, core oils, and metal cleaners, etc.

R. C. A. Victor plant at Camden, N. J., has added about 1200 employees to the payroll. The increase was made possible by favorable acceptance by R. C. A. Victor dealers of the 1939 series of radio and victrola models and the orders for the new instruments which followed their introduction. Public reaction to the new models will determine rate of operations of the Camden plant.

Electroplater and Polisher Wanted

The Department of the Interior has issued a circular announcing an examination for the post of electroplater at $1,860 a year and a buffer and polisher at $1,680 per year, to work in Washington, D. C. For full details write for application forms to the *Secretary of the Board of U. S. Civil Service Examiners* at any first class post office; or to the *U. S. Civil Service Commission*, Washington, D. C.; or to the *U. S. District Office* in Atlanta, Ga., New Post Office Bldg.; Boston, Mass., Post Office & Courthouse Bldg.; Chicago, Ill., New Post Office Bldg.; Cincinnati, Ohio, Post Office Bldg.; Denver, Colo., Post Office Bldg.; New Orleans, La., Customhouse; New York, N. Y., Federal Bldg., Christopher St.; Philadelphia, Pa., Tenth Floor, Gimbel Bldg.; Seattle, Wash., Federal Office Bldg.; St. Louis, Mo., New Federal Bldg.; St. Paul, Minn., New Post Office Bldg.; San Francisco, Calif., Federal Office Bldg.; Honolulu, T. H., Federal Bldg.; Balboa Heights, Canal Zone, Secretary, Board of U. S. Civil Service Examiners; San Juan, P. R., Chairman, Puerto Rican Civil Service Commission.

Applications must be on file with the U. S. Civil Service Commission, Washington, D. C., not later than August 15, 1938, if received from States other than the following: August 18, 1938, if received from the following states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

Oakite Sales Rearrangement

Oakite Products, Inc., 22 Thames St., New York, N. Y., manufacturers of cleaning materials for the metal-working industry, announce a divisional rearrangement of their Eastern field sales and service organization, effective August 1. Due to the serious illness of *J. A. Maguire*, the Detroit Division Manager, which will incapacitate him for active work for a considerable period, the Company has appointed *H. C. Duggan* to take charge of sales and service in that division. Mr. Duggan after having served previously both as an Oakite sales representative and division manager in the Midwest for eleven

years, came to New England as Division Manager in 1935. His appointment as Detroit Division Manager, therefore, marks his return to an industrial section with which he is thoroughly familiar and he will now be in charge of the sixteen men who comprise that division. His headquarters will be in the General Motors Bldg., Detroit.

As a result of these changes, the Company's New York and New England Divisions have been consolidated into one unit, to be known hereafter as the Northeastern Division. *D. X. Clarin*, New York Division Manager, who has been associated with the Company for the past 19 years, will head the eighteen Oakite Sales Representatives in the new consolidated division. His headquarters, as heretofore, will be the Company's General Offices in New York City.

Metal Market Review

July 25, 1938

Copper staged a complete reversal of the trend of many months. The first evidence appeared on June 20th (noted in our July report) when foreign copper climbed over 9c per pound, C.I.F. During the week of June 27th sales suddenly leaped to 32,550 tons. During the following week the metal was advanced to 9.25, 9.50 and 9.75c per lb., Electrolytic, delivered Connecticut Valley, and sales skyrocketed to 115,886 tons. Sales the next two weeks went down as sharply as they had risen but the price remained firm, bolstered by the buoyant though variable export market. On July 22nd the price was lifted again to 9.875 and on July 25th to 10c. Foreign market 10.22.

Sales week by week were 6,604 tons; 32,550; 115,886; 5,782 and 5,543 to the enormous total of 166,365 tons, compared with 19,235 tons for the previous four weeks. Sales for June totalled 90,978 tons compared with 18,853 tons in May. Statistics for June showed a reduction in stocks in the United States of 10,838 tons and an increase abroad of 7,977 tons.

Foreign copper output has been cut to 95% of effective tonnages. The market at this writing is decidedly strong.

Zinc, as last reported in this column had risen suddenly from 4.00 to 4.40c per pound. Prime Western, E. St. Louis. It continued to rise, selling now at 4.75. Sales leaped upward and then receded but without reduction in price. June statistics showed a gain in stocks of 1,551 as against an increase of 12,882 tons in May. Unfilled orders increased from 23,444 tons in May to 41,785 tons in June. Present situation firm.

Lead has also shown sharp improvement like copper and zinc, being last quoted here at 4.20c per pound E. St. Louis. The rise continued steadily to the present figure, 4.75c. Sales week by week were 9,206 tons; 11,567 tons; 10,931 tons; 5,041 tons; 2,132 tons, a total of 38,877 tons compared with 21,461 tons in the previous four weeks. Stocks of refined lead

were up 7,008 tons in May and for June, were down by 377 tons. Present situation firm.

Tin naturally took an important part in the upward movement. From a low of under 36c per lb. Straits, last month, it moved upward, at first steadily and then rapidly, being last quoted here at 42.60, and advancing from there to a high of 44; present price 43.50. Although actual consumption is still depressed due to the low state of the canning industry, the tin production schedule of 45% with 10% of the total output allocated toward building up of the Buffer Pool Stocks, is keeping the supply close enough to the demand to put the market in much stronger condition.

Present situation steady.

Aluminum entered the market headlines with the news that British interests had cut their price by 10%. American price unchanged at 20c per pound for 99% plus.

Silver unchanged at 42.75c per ounce, New York official.

Platinum joined the upward move going to $33.-$36. per ounce Troy.

Scrap Metals, of course, moved upward in prices and demand. Brass ingots improved with large buying although aluminum lagged behind. Lately the former has been slowing down while the latter has become a little more active.

On July 1st unfilled orders on the books of the members of the Non-Ferrous Ingot Metal Institute amounted to 15,864 net tons against 8,745 on June 1st.

The combined deliveries of brass and bronze ingots and billets for the members in the month of June amounted to 3,800 tons compared with 2,782 tons in May.

	4 wks. end. July 8	4 wks. end. June 10
80-10-10	10.828	11.076
78% Metal	8.254	8.360
81% Metal	8.515	9.062
83% Metal	8.838	8.868
85% Metal	9.070	9.282
No. 1 Yellow	7.583	7.871

Average Prices for Metals

	June
COPPER c/lb. Duty 4c/lb.	
LAKE (del. Conn. Producers' Prices)	9.062
ELECTROLYTIC (del. Conn. Producers' Prices)	9.000
CASTING (f.o.b. ref.)	8.536
ZINC (f.o.b. E. St. Louis) c/lb. Duty 1¾ c/lb.	
Prime Western (for Brass Special add 0.10)	4.143
TIN (f.o.b. N. Y.) c/lb. Duty Free, Straits	40.347
LEAD (f.o.b. St. L.) c/lb. Duty 2⅛ c/lb.	4.25
ALUMINUM c/lb. Duty 4 c/lb.	20.000
NICKEL c/lb. Duty 3 c/lb. Electrolytic 99.9%	35.000
ANTIMONY (Ch.) c/lb. Duty 2 c/lb.	13.943
SILVER c/oz. Troy, Duty Free	42.75
PLATINUM $/oz. Troy, Duty Free	31.636
GOLD—Official U. S. Treasury Price	35.000

Supply Prices, July 27, 1938

Anodes

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 2,000 lbs. or more, and subject to changes due to fluctuating metal markets.

COPPER: Cast ..... 18⅝c. per lb.
Electrolytic, full size, 13⅝c. cut to size .. 13⅝c. per lb.
Rolled oval, straight, 14⅛c.; curved .... 15⅛c. per lb.
BRASS: Cast ..... 17⅜c. per lb.
ZINC: Cast ..... 9⅜c. per lb.

NICKEL: 90-92%, 16" and over ..... .45 per lb.
95-97%, 16" " " ..... .46 per lb.
99%+cast, 16" and over, 47c.; rolled, depolarized, 16" and over, 48.
SILVER: Rolled silver anodes .999 fine were quoted July 28, from 46c. per Troy ounce upward, depending on quantity.

White Spanish Felt Polishing Wheels

Diameter	Thickness Under ½"	½-15/16"	1-2"	2-3½"	Over 3½"
Under 1"	6.35-6.40	6.20-6.25	6.10-6.15	6.10-6.15	6.35-6.40
1" to 1 7/16"	5.85	5.70	5.60	5.60	5.85
1½" to 3 15/16"	5.55	5.35-5.40	5.30-5.35	5.30-5.35	5.60
4-5 15/16"	4.95-5.00	4.70-4.85	4.65-4.75	4.65-4.75	4.95-5.00
6", 8" & 9"	3.80-4.25	3.45-3.95	2.45-3.05	2.45-3.00	2.90-3.35
10" to 18"	3.80-4.25	3.45-3.95	2.45-2.95	2.45-2.85	2.90-3.25
Over 18"	3.80-4.25	3.45-3.95	2.70-3.05	2.70-3.00	2.90-3.35

Prices above are for less than 50 lb. For over 50 lbs. various discounts or deductions are allowed.

On grey Mexican wheels deduct 10c per lb. from above prices.

Cotton Buffs

Full disc open buffs, per 100 sections when purchased in lots of 100 or less are quoted:

16" 20 ply 84/92 Unbleached	$75.24
14" 20 ply 84/92 Unbleached	57.67
12" 20 ply 84/92 Unbleached	43.28
16" 20 ply 80/92 Unbleached	63.28
14" 20 ply 80/92 Unbleached	48.57
12" 20 ply 80/92 Unbleached	36.52
16" 20 ply 64/68 Unbleached	59.69
14" 20 ply 64/68 Unbleached	45.84
12" 20 ply 64/68 Unbleached	34.49

⅜" Sewed Buffs, per lb., bleached or unbleached 54c to 90c

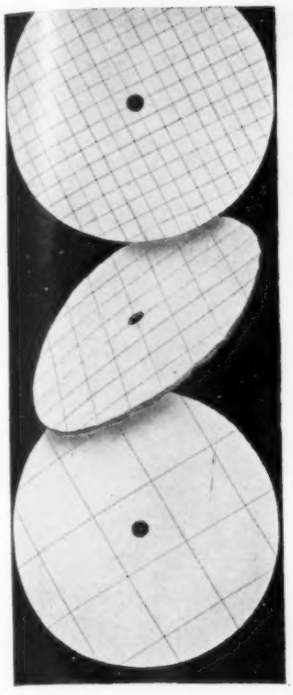
Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone C. P. l.c.l. Drums	lb.	.06¼
Acid—Boric (Boracic) granular, 99½+% ton lots	lb.	.054-.059
Chromic, 100 lb. and 400 lb. drums		.16¾-.17¼
Hydrochloric (Muriatic) Tech., 20 deg., carboys	lb.	.027
Hydrochloric, C. P., 20 deg., carboys	lb.	.08
Hydrofluoric, 30%, bbls.	lb.	.07-.08
Nitric, 36 deg., carboys	lb.	.06
Nitric, 42 deg., carboys	lb.	.07½
Sulphuric, 66 deg., carboys	lb.	.02½
Alcohol—Butyl, drums (f.o.b. destination)	lb.	.09½-.10
Alum—Lump, barrels	lb.	.0340-.0365
Powdered, barrels	lb.	.0355-.0380
Ammonia, aqua, com'l., 26 deg., drums, carboys	lb.	.02½-.05¼
Ammonium—Sulphate, tech., bbls.	lb.	.03½-.05
Sulphocyanide, technical crystals, kegs	lb.	.55-.58
Arsenic, white kegs	lb.	.04½-.05
Asphaltum, powder, kegs	lb.	.23-.41
Benzol, pure, drums	gal.	.41
Borax, granular, 99½+%, ton lots	lb.	.027-.032
Cadmium oxide, 50 to 1,000 lbs.	lb.	1.20
Calcium Carbonate (Precipitated Chalk), U. S. P.	lb.	.05¾-.07½
Carbon Bisulphide, drums	lb.	.05¾-.06
Chrome, Green, commercial, bbls.	lb.	.22
Chromic Sulphate, drums	lb.	.26¼
*Copper—Acetate (Verdigris)	lb.	.25
Carbonate, 53/55% cu., bbls.	lb.	.14-.15
Cyanide (100 lb. kgs.)	lb.	.34
Sulphate, tech., crystals, bbls.	lb.	.0485
Cream of Tartar Crystals (Potassium Bitartrate)	lb.	.20¼-.20½
Crocus Martis (Iron Oxide) red, tech., kegs	lb.	.07
Dextrin, yellow, kegs	lb.	.05-.08
Emery Flour (Turkish)	lb.	.07
Flint, powdered	ton	30.00
Fluorspar, bags	lb.	.03½
*Gold Chloride	oz.	$18¼-23
*Gold Cyanide, Potassium 41%		$15.45
*Gold Cyanide, Sodium 46%		$17.10
Gum—Sandarac, prime, bags	lb.	.50
Shellac, various grades and quantities	lb.	.21-.31
Iron Sulphate (Copperas), bbls.	lb.	.016
Lead—Acetate (Sugar of Lead), bbls.	lb.	.10-.12¾
Oxide (Litharge), bbls.	lb.	.12½
Lime Compositions for Nickel	lb.	.09½-.11
Lime Compositions for Brass	lb.	.09½-.11
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Methanol, (Wood Alcohol) Pure, drums l.c.l.	gal.	.40½
Nickel—Carbonate, dry bbls.	lb.	.36-.41
Chloride, bbls.	lb.	.18-.22
Salts, single, 425 lb. bbls.	lb.	.13½-.14½
Salts, double, 425 lb. bbls.	lb.	.13½-.14½
Paraffin	lb.	.05-.06
Phosphorus—Duty free, according to quantity	lb.	.35-.40
Potash Caustic Electrolytic 88-92% broken, drums	lb.	.07¼-.08⅝
Potassium—Bichromate, casks (crystals)	lb.	.09⅛
Carbonate, 98-100%	lb.	.06¾
Cyanide, 165 lbs. cases, 94-96%	lb.	.52½
Pumice, ground, bbls.	lb.	.03
Quartz, powdered	ton	$30.00
Rosin, bbls.	lb.	.04½
Sal Ammoniac (Ammonium Chloride) in bbls.	lb.	.05-.07½
*Silver—Chloride, dry, 100 oz. lots	oz.	.38¾
Cyanide, 100 oz. lots	oz.	.42¾
Nitrate, 100 ounce lots	oz.	.33¼
Soda Ash, 58%, bbls.	lb.	.0235
Sodium—Cyanide, 96% minimum, 100 lb. drums	lb.	.15
Hyposulphite, kegs, bbls.	lb.	.03½-.06½
Metasilicate, granular, bbls.	lb.	3.15
Nitrate, tech., bbls.	lb.	.029
Phosphate, tribasic, tech., bbls.	lb.	.03
Silicate (Water Glass), bbls.	lb.	.01½
*Stannate, drums	lb.	.29-.31½
Sulphocyanide, drums	lb.	.30-.35
Sulphur (Brimstone), bbls.	lb.	.02¾
*Tin Chloride, 100 lb. kegs	lb.	.35½
Tripoli, powdered	lb.	.03
Trisodium Phosphate—see Sodium Phosphate.		
Wax—Bees, white, ref. bleached	lb.	.60
Yellow, No. 1	lb.	.45
White Silica Compositions for Brass	lb.	.07½-.10
Whiting, Bolted	lb.	.02½-.06
Zinc—Carbonate, bbls.	lb.	.14-.15
Cyanide (100 lb. kegs)	lb.	.33
Chloride, drums, bbls.	lb.	.065
Sulphate, bbls.	lb.	.04

* Subject to fluctuations in metal prices.

Metal Prices on page 412.



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PUT a Yerges buff to work on any job in your shop, from hardest, fastest cutting to softest buffing or polishing. See for yourself how much faster and better the Yerges buff does the work. Check the cost and see how much money the Yerges buff saves on that operation.

The extraordinary performance and long life of the Yerges buff are the result of our exclusive bias-cut, square-stitched construction. The buff presents an absolutely uniform face to the work throughout its entire diameter. Made for every requirement. Ask for samples and data. The Yerges Mfg. Company, Fremont, Ohio.

YERGES

THE PROOF OF THE PUDDING

is in the eating. The proof of an anode is in the using. That's why YOU should be interested in the tremendous number of *repeat orders* we are getting on

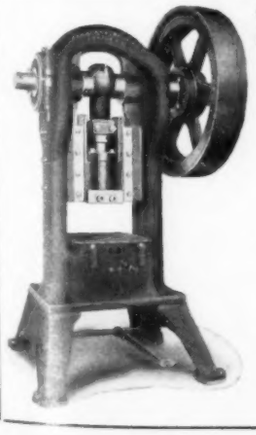
MULTI-EDGE

The New Anode For Chrome Plating

It has 8 Corners for greater throwing power. An increasing number of nationally known firms are steady, satisfied users of this superior anode. For prices and full information, get in touch with your nearest Supply House or write to

REPUBLIC LEAD EQUIPMENT CO.

7928 Jones Rd. L. R. SCHLUNDT *Manager* Cleveland, Ohio



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Manufacturers of

Straight Side Presses
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Toggle Presses
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Special Presses
Roll and Dial Feeds

Besplate

NICKEL ANODES

ARE QUALITY PRODUCTS . . .

LEADERS in the Nickel Plating Industry have standardized on McGean Besplate 99% Nickel Anodes — Because

1. Cathode Deposits are smoother
2. Anode corrosion is excellent
3. Less frequent filtering of solution required

◆◆◆◆◆

We Also Offer

Genuine Rolled Oval
Depolarized Nickel Anodes

◆◆◆◆◆

From our complete line of Anodes and Plating Chemicals we call your attention to the following:

ANODES

Nickel (all percentages)	Tin
Copper	Brass
Cadmium	Zinc

CHEMICALS

Nickel Salts	Copper Sulphate
Nickel Chloride	Copper Cyanide
Nickel Carbonate	Copper Carbonate
Chromic Acid	Cadmium Oxide

Manufactured by

THE McGEAN CHEMICAL COMPANY
CLEVELAND, OHIO

McGEAN CHEMICALS

Metal Prices, July 27, 1938

(Import duties and taxes under U. S. Tariff Act of 1930, and Revenue Act of 1932)

New Metals

COPPER: Lake, 10.125, Electrolytic, 10.00, Casting, 9.525.
ZINC: Prime Western, 4.75. Brass Special, 4.85.
TIN: Straits, 43.65. LEAD: 4.75.
ALUMINUM: 20. ANTIMONY, Ch. 14.00.
NICKEL: Shot, 36. Elec., 35.

QUICKSILVER: Flasks, 75 lbs., $81. BISMUTH, $1.05.
CADMIUM, .85-$1.20. SILVER, Troy oz., official pr. N. Y., July 27, 42¾c.
GOLD: Oz. Troy, Official U. S. Treasury price $35.00.
SCRAP GOLD, 6¾c. per pennyweight per karat, dealers' quotation.
PLATINUM, oz. Troy $33-36.

Duties: Copper, 4c. lb.; zinc, 1¾c. lb.; tin, free; lead, 2½c. lb.; aluminum, 4c. lb.; antimony, 2c. lb.; nickel, 3c. lb.; quicksilver, 25c. lb.; bismuth, 7½%; cadmium, 15c. lb.; cobalt, free; silver, free; gold, free; platinum, free.

Ingot Metals and Alloys

	Cents lb.	Duty	U. S. Import Tax*
No. 1 Yellow Brass	8.875	None	4c. lb.[1]
85-5-5-5	10.75	None	4c. lb.[1]
88-10-2	14	None	4c. lb.[1]
80-10-10	12.50	None	4c. lb.[1]
Manganese Bronze (60,000 t. s. min.)	11.25	None	4c. lb.[1]
Aluminum Bronze	15.50	None	4c. lb.[1]
Monel Metal Shot or Block	28	25% a. v.	None
Nickel Silver (12% Ni)	13.25	20% a. v.	4c. lb.[1]
Nickel Silver (15% Ni)	15.50	20% a. v.	4c. lb.[1]
No. 12 Aluminum	15.50-19	4c. lb.	None
Manganese Copper, Grade A (30%)	22-27	25% a. v.	3c. lb.[1]
Phosphor Copper, 10%	15.00	3c. lb.	4c. lb.[1]
Phosphor Copper, 15%	16.00	3c. lb.	4c. lb.[1]
Silicon Copper, 10%	21.50	45% a. v.	4c. lb.[1]
Phosphor Tin, no guarantee	50-60	None	None
Iridium Platinum, 5% (Nominal)	$37.75	None	None
Iridium Platinum, 10% (Nominal)	$39.50	None	None

* Duty is under U. S. Tariff Act of 1930; tax under Section 60 (7) of Revenue Act of 1932.
[1] On copper content. [2] On total weight. "a. v." means ad valorem.

Old Metals

Dealers' buying prices, wholesale quantities:	Cents. lb.	Duty	U. S. Import Tax
Heavy copper and wire, mixed	6⅞ to 7⅛	Free	4c. per pound on copper content
Light copper	6½ to 6⅝	Free	
Heavy yellow brass	4⅝ to 4⅞	Free	
Light brass	4½ to 4⅝	Free	
No. 1 composition	6¼ to 6½	Free	
Composition turnings	6⅛ to 6¼	Free	
Heavy soft lead	4⅛ to 4¼	2⅛c. lb.	None
Old zinc	2½ to 2¾	1½c. lb.	
New zinc clips	3½ to 3⅝	1½c. lb.	
Aluminum clips (new, soft)	12½ to 13	4c. lb.	
Scrap aluminum, cast	7 to 7½	4c. lb.	
Aluminum borings—turnings	4	4c. lb.	
No. 1 pewter	23 to 25	Free	
Electrotype	4¼ to 4⅜	2⅛c. lb.*	
Nickel anodes	29 to 30	10%	
Nickel clips, new	30 to 31	10%	
Monel scrap	7½ to 13½	10% av.	

* On lead content.

Wrought Metals and Alloys

The following are net BASE PRICES per pound, to which must be added extras for size, shape, quantity, packing, etc., or discounts, as shown in manufacturers' lists, effective since July 29, 1938. Basic quantities on most rolled or drawn brass and bronze items below are from 2,000 to 5,000 pounds; on nickel silver, from 1,000 to 2,000 pounds.

Copper Material

	Net base per lb.	Duty*
Sheet, hot rolled	18¼c.	2½c. lb.
Bare wire, soft, less than carloads	14¼c.	25% a. v.
Seamless tubing	18¾c.	7c. lb.

* Each of the above subject to import tax of 4c. lb. in addition to duty under Revenue Act of 1932.

Nickel Silver

Net base prices per lb. (Duty 30% ad valorem.)

Sheet Metal		Wire and Rod	
10% Quality	25¼c.	10% Quality	27⅞c.
15% Quality	26⅝c.	15% Quality	31⅛c.
18% Quality	27⅝c.	18% Quality	34 c.

Brass and Bronze Material

	Yellow Brass	Red 80%	Brass	Comm'l. Bronze	Duty	U. S. Import Tax
Sheet	16¾c.	17½c.	18⅜	4c. lb.		
Wire	17 c.	17¾c.	18½	20%		4c. lb. on copper content.
Rod	12¾c.	17¾c.	18½	4c. lb.		
Angles, channels	25¼c.	26 c.	26⅞	12c. lb.		
Seamless tubing	19½c.	20 c.	20¾	8c. lb.		
Open seam tubing	25¼c.	26 c.	26⅞	20% a. v.		

Tobin Bronze and Muntz Metal

(Duty 4c. lb.; import tax 4c. lb. on copper content.)

Net base prices per pound.	
Tobin Bronze Rod	18⅝c.
Muntz or Yellow Rectangular and other sheathing	20 c.
Muntz or Yellow Metal Rod	16½c.

Aluminum Sheet and Coil

(Duty 7c. per lb.)

Aluminum sheet, 18 ga., base, carload lots, per lb.	33.00c.
Aluminum coils, 24 ga., base price, carload lots, per lb.	28.50c

Rolled Nickel Sheet and Rod

Net Base Prices

Cold Drawn Rods	50c.	Standard Cold Rolled Sheet	49c.
Hot Rolled Rods	45c.		

Monel Metal Sheet and Rod

Hot Rolled Rods (base)	35c.	No. 35 Sheets (base)	37c.
Cold Drawn Rods (base)	40c.	Std. Cold Rolled Sheets (base)	39c.

Silver Sheet

Rolled sterling silver (July 27) 45c. per Troy oz. upward according to quantity. (Duty, 65% ad valorem.)

Zinc and Lead Sheet

	Cents per lb. Net Base	Duty
Zinc sheet, carload lots standard sizes and gauges, at mill, less 7 per cent discount	9.75	2c. lb.
Zinc sheet, 1200 lb. lots (jobbers' prices)	10.75	2c. lb.
Zinc sheet, 100 lb. lots (jobbers' prices)	14.75	2c. lb.
Full Lead Sheet (base price)	7.75	2⅜c. lb.
Cut Lead Sheet (base price)	8.00	2⅜c. lb.

Block Tin, Pewter and Britannia Sheet

(Duty Free)

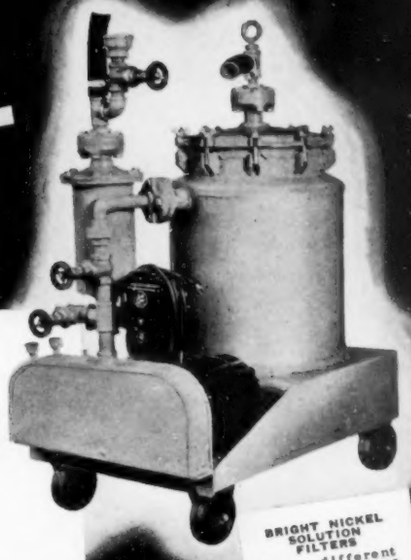
This list applies to either block tin or No. 1 Britannia Metal Sheet, No. 23 B. & S. Gauge, 18 inches wide or less; prices are all f. o. b. mill:

500 lbs. over	15c. above N. Y. pig tin price
100 to 500 lbs.	17c. above N. Y. pig tin price
Up to 100 lbs.	25c. above N. Y. pig tin price
Up to 100 lbs.	25c. above N. Y. pig tin price

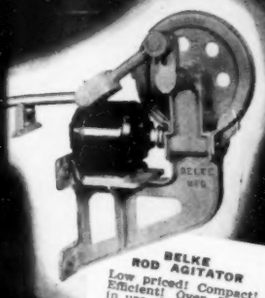
Supply Prices on page 419.

Special Equipment for BRIGHT NICKEL

RUBBER LINED TANKS
Sheet Rubber or Sprayed Rubber No matter what bright nickel solution you decide on we can furnish the proper rubber lining for the job.



BRIGHT NICKEL SOLUTION FILTERS
Seven different sizes to choose from. Capacities from 300 to 2,000 gallons per hour.



BELKE ROD AGITATOR
Low priced! Compact! Efficient! Over 5,000 in use. Immediate delivery. Single or double rod types.

RACKS-TANKS-EQUIPMENT

IN keeping with its reputation of being first with the latest development for the plating industry the Belke Manufacturing Company now offers seven important products especially designed for Bright Nickel Solutions.

. . . Rubber lined tanks for every type of solution.

. . . Rod agitators to increase efficiency and speed up plating.

. . . Semi-Automatic Conveyors with a double cathode track to carry the increased current necessary for Bright Nickel.

. . . The Scrap Anode Basket to use up all small pieces of Bright Nickel Anodes.

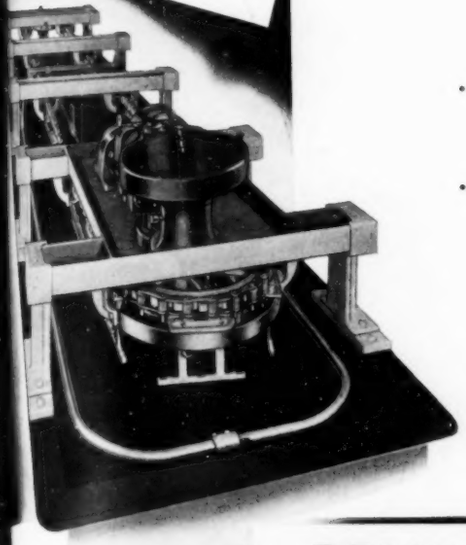
. . . Rubber Insulated Plating Racks for Bright Nickel and Chrome with spring type contacts for positive conductivity.

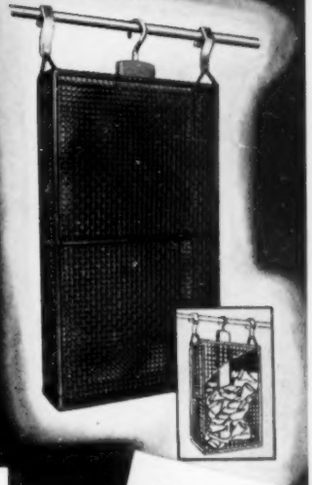
If you already have or are contemplating a Bright Nickel installation let a Belke Engineer assist you in getting the most out of your solution.

Write for complete bulletins on any of the above products!

STREAM LINED ROD AGITATOR
Keeps the work continuously moving into fresh solution. Prevents gas bubbles and burning. Four times faster plating.

TANK RHEOSTATS
Particularly adapted for bright nickel. The only rheostat on the market offering single amperage steps from 1 to 10,000.





BELKE SCRAP ANODE BASKET
Uses up all scrap pieces of anode. Will pay for itself in 30 days. The biggest money saver in the plant.

SEMI-AUTOMATIC PLATING CONVEYOR
Rugged! Efficient! The double cathode track will carry 6,000 amperes from one lead-in. The only conveyor for Bright Nickel.

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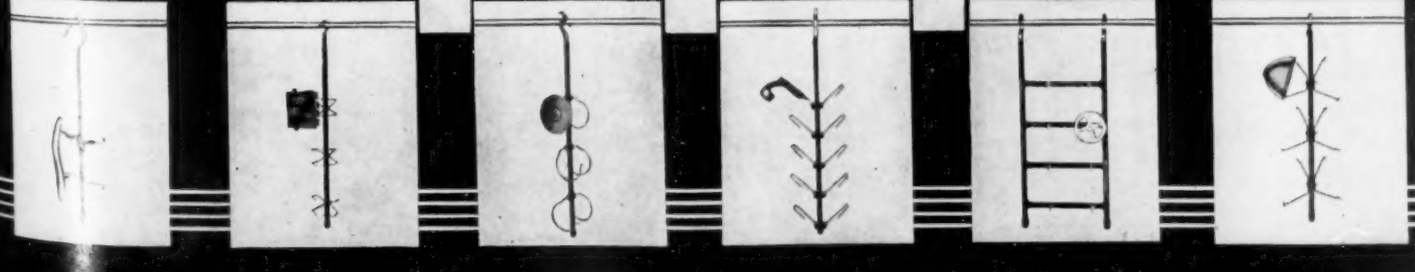
947 N. Cicero Avenue, Chicago, Ill.

HARD RUBBER COVERED PLATING RACKS FOR BRIGHT NICKEL AND CHROME



Founded January, 1903 by
PALMER H. LANGDON
1868-1935

METAL INDUSTRY

VOLUME 36 SEPTEMBER, 1938 NUMBER 9

Publication Office:
116 John Street, New York

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DEPARTMENTS

***METAL INDUSTRY** articles are listed regularly in the Engineering Index and the Industrial Arts Index.*